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Open cut working of the Rhodesia Broken Hill Development Co., in Northern Rhodesia. Deposits of lead, zinc and vanadium ores are being mined at this property

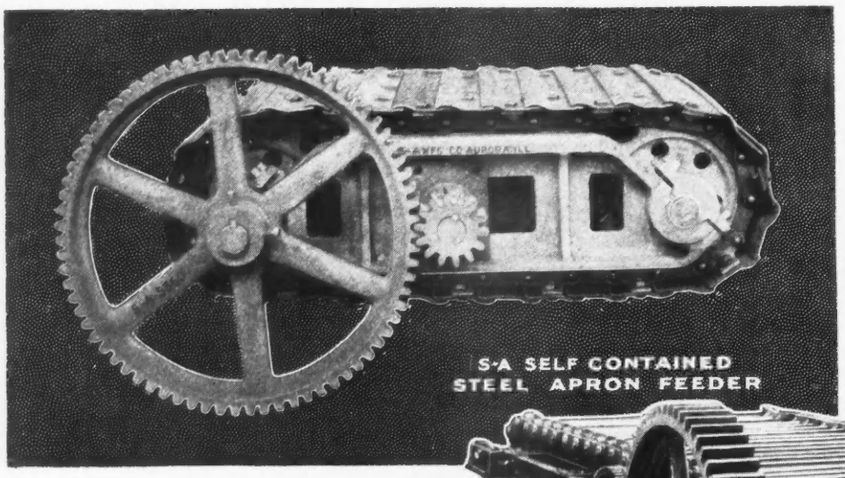
Photograph by courtesy of Owen Letcher, Johannesburg

The Tacoma Copper Smelter and Refinery, by George J. Young

Reclosing Equipment for Mines, by E. L. Hough

Development of the New Platinum Field in the Transvaal, by Owen Letcher

Biography of Stephen Birch



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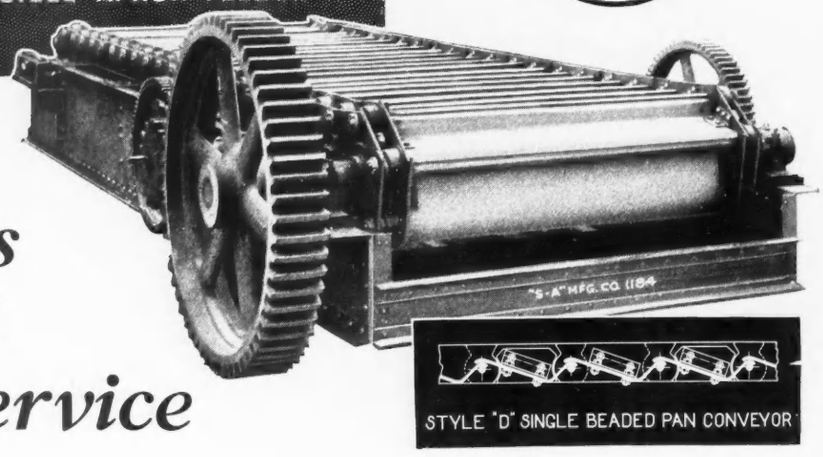

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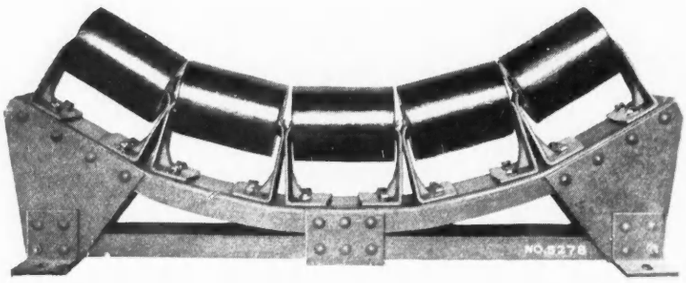

ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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A Platinum Rand?

THE ARTICLE on the Transvaal platinum discoveries, in this issue, by the Editor of the *South African Mining and Engineering Journal*, is of unusual interest. Mr. Letcher mailed us his article the day of his return to Johannesburg from a trip through the platinum fields. He regards the platinum discoveries "as of prime importance."

As the article states, and the map shows, the platinum belt is of considerable length—a matter of 60 miles. The first discovery in this (Lydenburg) belt was made last June, and consisted of alluvial platinum. It was discovered in pyroxenite and associated ultra-basic rocks in August. In September one of these basic rocks (norite) was found to contain 2 to 4 dwt. of platinum for a band up to 40 ft. in thickness. This band proved to be extraordinarily persistent.

In 1923 platinum had been discovered in the Waterberg, 100 miles west of the Lydenburg line. In the Waterberg the platinum had the till then practically unheard of occurrence of being in a quartz vein or veindike. But the Lydenburg platinum has the more orthodox occurrence of being in ultra-basic igneous rocks. This is the occurrence in Russia, and first detected there; but the bedrock deposits are of such low grade as not to be of economic value in any case. All the Russian platinum is of placer origin. This is also true of the second great source of platinum, Colombia. Bedrock platinum of value was indeed for a long time unknown; but in the United States the Rambler mine, in Wyoming, has produced some platinum ore, and the Boss mine, in Nevada, more; while the Salt Chuck mine, in Alaska, has produced some ore containing the platinoid metals. Nevertheless, the fact remains that bedrock platinum has not been a factor in the supply or in the price. But in the Lydenburg district there is also placer platinum, it is reported; and with the reported values in the rocks, there should be found gravels of considerable richness. At the same time, some of the bedrock concentrations, as reported by Mr. Letcher, are of considerable value, small lots of ore running an ounce to the ton. The low-grade bedrock ore is reported as averaging 2 to 3 dwt. in "enormous tonnages."

Mr. Letcher concludes that we have here "in all probability the most important platiniferous occurrence discovered anywhere in the history of the world."

From the data given above this may well be true. There is always something new coming out of Africa, and it may well be that this region will surpass the Urals and Colombia, a performance which would not be difficult. Nevertheless, calculations of net profit on these mines should be most cautiously made. If they are based on the present figure of $117 an ounce, they will be built on sand. It is not so very, very long ago that platinum was cheaper than gold. The restricted supply has run the price up; and when it became so much dearer than gold, the wearers of jewelry took it up, and ran the price still higher by this demand. If there is anything like the abundant supply of platinum in the Transvaal which is indicated, the first result will be a headlong tumble of platinum prices. If platinum becomes cheap, it will go out of fashion for jewelry, for which it has small recommendation besides its price; and this will further lessen the demand. Therefore, the investor should make haste slowly.

When to Buy Mines

THERE IS of course a right and a wrong period in the economic cycle to invest in mining enterprises and in mining stocks. This is a subject to which mining capital in general has given little thought. The average investor who buys into the stocks of industrial, public utility, and railroad enterprises does so when they are prosperous. When business is flourishing and companies are making great money, he buys into them, through their stocks and bonds. If a turn of the wheel comes, as it always has in past economic history, and a business depression ensues, he finds that the companies whose stocks and bonds he holds are having a struggle: he finds, moreover, his capital impaired and the market price of the stocks and bonds very much shrunken. He may decide to sell out and take his loss, under the circumstances; but a year or two later he may find that these same enterprises have recovered their earning power and their market value. If our investor continues his policy he may eventually part with all his capital.

Similarly, in the mining industries, when a certain metal is much in demand, capital rushes into that industry, and its stocks and bonds readily command excellent prices. New mines are readily sold and money for equipment is easily forthcoming. But by the time they are ready for production, it may well be that the economic wheel has turned and that this particular industry is depressed.

It is well recognized that the investor in stocks and bonds should buy them when they are cheap and sell them when they are dear. They will be cheap only when industry is depressed and the average investor is shy of them. It should be equally well recognized by mining investors, that the same principle applies to mines. At the present time, for example, there is rather more than an abundant supply of copper; and the price of copper is relatively depressed. New copper mines are not in demand, therefore, and may be had cheap. For the man of patience and foresight, this is the time to buy copper mines, although it may be that he will wait for some years for the full fruition of his investment.

Taking mining in general, this is a good period for the capitalist to acquire promising mines. In general, and in the long run, metals will become more and more in demand; and there is not a corresponding supply in sight. This is even true of gold mining, whose pros-

perity depends so largely upon the cost of other commodities, which determine the cost of mining and reducing gold. The outlook is that in the long run the commodity index will sink; it is altogether unlikely that it will rise.

This is the right time, therefore, to secure mining properties which would almost pay for working, and to hold them till the price of metal and the cost of working becomes more favorable. As to mining stocks, the case is somewhat different, in that many of these stocks have been carried up with stocks, in general, in a bull market, which, according to all precedent, will be followed by a declining market, which will carry down most active stocks.

Basic Dikes and Ore Deposits

IGNEOUS DIKES are a very frequent though not at all an invariable accompaniment of ore deposits. These dikes are of all kinds—siliceous, intermediate, and basic. There was a time—some twenty or thirty years ago—when geologists were inclined to think that basic dikes had a far closer genetic relation to ore deposits than had the siliceous or intermediate varieties. This belief has been almost entirely forgotten, the tendency now being to stress the evident close relation between siliceous and intermediate dikes and other forms of intrusion. Nevertheless, it is borne in upon the veteran observer with increasing strength that basic dikes, of the kinds known as trap, diabase, basalt, lamprophyre, and the like, frequently occur in connection with ore deposits. With the development of a more accurate science of ore deposits, and the recognition of a definite time or injection period for ore solutions or ore magmas, as well as igneous dikes, it has been recognized that in many cases these basic dikes are later than the associated ones; and hence the tendency has been to dismiss the dikes as having no genetic connection with the ore. This, however, is a conclusion which is not logical, as will be seen on reflection; there may be a genetic connection between an ore vein or veindike and an igneous dike, regardless of which was injected first. The basic dikes, as a matter of fact, distinguish themselves by playing both rôles, that of earlier and that of later dikes—in so many cases that they finally arrest the attention and lead to the suspicion that these constantly reiterated relations mean something yet unrecognized.

In a paper read before the Geological Society of America, in Ithaca, December, 1924, J. E. Spurr analyzed a number of these instances and advanced the explanation that the essential general contemporaneity in so many cases of basic dike injections and ore injections was due to both crystallizing and consolidating at very close to the same temperature. This would mean that basic magmas consolidate in depth at a much lower temperature than was formerly supposed—indeed, at a temperature even lower than that of the freezing of granite, which it has long been agreed consolidated at a comparatively low temperature, being more of a solution than a melt, on account largely of water and volatile elements in the magma. It is certain that basic magmas also contain these volatile elements, although probably in not so large a proportion; and it appears altogether likely that they perform a similar function to that which they accomplish in siliceous magmas—of lowering greatly the temperature of consolidation compared with what it would be if the magma were simply a melt. It is universally acknowledged now that none of these magmas—basic or siliceous—is comparable to a melt; they are to be regarded as heated complex solutions.

If we once get the right conception of the relation of these basic dikes to the ores in conjunction with which they occur, there will result a better conception of many things which cannot here be enumerated.

A Market Place for Minerals

A FEW DAYS AGO a mineral dealer called at our office to remonstrate politely at the publication of our mineral quotations. He doubted the wisdom of publishing quotations covering some of the rarer non-metallic minerals and metals, those that are only sold infrequently, but did not vouchsafe any valid reason for his contention. One might have inferred from his remarks, however, that his business was affected by our action, as he no longer was able to tell a mineral producer that, say, bauxite was worth so much per ton, and have his quotation stand unquestioned. Now that *Mining Journal-Press* quotes nearly every mineral and metal of commercial value, anyone interested can quickly determine the market price of both common and uncommon minerals. The quotations act as a check for the producer. Before *Mining Journal-Press* took up the work of expanding its market quotations to include all the minerals, it was a simple matter for a broker or dealer to build up a business in certain unusual ores and minerals on the strength of his private knowledge of the market value of these commodities. That condition is fast disappearing. And in fairness to all parties it should disappear. This also explains why some dealers have been reluctant to co-operate with us in establishing prices, although we are happy to say that the most influential metal and mineral dealers have sincerely co-operated and have been most helpful. At present we enjoy the assistance of producers, consumers, and dealers throughout the United States and Canada. The list is constantly expanding.

Producers have found it most advantageous at times to have their sales prices a matter of record in our pages, because it has often stimulated their business, for we have been glad to refer any inquiries that reach us about published prices to the parties helping us establish those prices.

Although the number of minerals quoted in our market section covers almost all minerals and metals, we are continually adding new quotations to the groups. Our goal is to make the quotations as complete as possible. By doing so we believe that we afford the mineral producer and consumer an invaluable service in giving him a market place.

Helium and Caisson Disease

ACCORDING to a recent announcement, J. H. Hildebrand, of the Department of Chemistry of the University of California, has discovered that if helium be substituted for nitrogen in the air used in caissons where operations are conducted under high pressure, the resulting atmosphere prevents caisson disease. As is well known, nitrogen is absorbed by the blood and body tissues when workers are under high air pressures, and is released in a gaseous state when the pressures are reduced. Frequently it is not eliminated with sufficient rapidity, and, under such circumstances,

it forms bubbles, which are often fatal. The gradual release from high pressures by confining the workers in an air lock for a definite time period has been found effective in controlling the difficulty, which is acute in proportion to the pressures in the chambers.

Professor Hildebrand points out that helium is not absorbed by the body as easily as nitrogen, although it can take the place of nitrogen as far as breathing is concerned. The small amount of helium that is absorbed escapes from the body in one-sixth the time required by nitrogen, so that there is little danger of bubbles forming in the body tissues. Professor Hildebrand's idea has apparently been found by the U. S. Bureau of Mines to be of value.

The use of a helium-oxygen atmosphere, synthetic air, for high-pressure caisson work should be practicable and should materially lessen the danger of such work. This is of importance to engineers who are engaged in difficult foundation work, for it may extend the application of caisson as well as deep-sea diving operations to greater depths than are now possible.

Jackknives and Copper

SEVERAL YEARS AGO an office secretary systematically cruised the editorial offices of the McGraw-Hill establishment in New York in search of a "regular" jackknife with which to cut a heavy piece of cardboard. The search was unavailing, until one of the assistant editors of the *Mining Journal-Press* was found who was able to produce the needed article. This incident is of interest in showing the inroads of civilization upon the knife-carrying propensities of the male. Nevertheless a large proportion of men manage to carry pocket knives as an essential part of their personal equipment. We are informed by the Copper and Brass Research Association that 30,000,000 pocket knives are presumed to be in service at any given time. What is more to the point as far as the mining industry is concerned is the fact that the 30,000,000 people so equipped are lugging around in their jeans at least 1,000,000 lb. of brass in addition to the steel. Pocket knives and safety pins consume in excess of 6,000,000 lb. of copper and its alloys annually. This is a small fraction of the copper production, but it is one of the many rivulets of copper that drain our copper mines.

Not so very long ago, bronze and copper insect-screen was hard to get. Hardware retailers would search around and perhaps unearth a modest roll of the stuff if the customer was insistent enough. Now, however, retail hardware dealers brazenly carry it out in the front aisle of their stores, and 8,000,000 lb. of copper is consumed in the manufacture of bronze and insect-screen cloth, the demand for which now amounts to 55,000,000 sq.ft. per year.

Automobiles accounted for 165,000,000 lb. of copper and its alloys in 1924. Cane-sugar production in North and South America requires 26,000,000 lb. of copper tubing yearly; beet-sugar production in the United States and Canada accounts for 2,500,000 lb., and sugar refinery and miscellaneous demands necessitate 7,140,000, or a total of 35,640,000 lb. of copper for the sugar industry.

Under the stimulus of the application of sound marketing principles, the market for domestic copper has been widened and promises to maintain and expand in a healthy growth.

Kronic Kickers

A MORE MILD AND MODEST DEMAND than that made in Idaho's new "blue-sky" law would be hard to devise, and yet we understand that some of those folks to whom regulation of any kind regarding the sale of mining-company shares is a bitter draught are kicking vigorously. The principal provision of the new law is that before he shall "distribute or publicly exhibit" any printed matter designed to assist the sale of stock, a mine promoter or vendor of shares shall file a copy with the State Inspector of Mines. That official has no authority to censor the prospectus or other matter or prevent its publication or distribution. The only purpose, it seems, is to give him an even start with the promoter if he feels that the general public should be warned regarding the proposed venture.

Heretofore, a man with stock to sell could, if careful, solicit in an inconspicuous way for months before his operations became known to the Inspector of Mines. If the stock were demonstrably of little or no value, large amounts of it might be disposed of before the authorities learned of its existence. We cannot see why any promoter with a legitimate and equitable enterprise —be it ever so much of a gamble—should object to filing copies of his "literature" with the Inspector of Mines. The law has had the support of the established mining interests in Idaho and of many of the mine promoters. We suspect that much of the opposition was the consequence not so much of any real objection to the law, as to the chronic habit of some honest people out there to fight on general principles anything that might be considered to come under the head of "blue-sky" legislation.

A Possible Accessory To the Mud Box

AT THE KIMBERLEY FLOTATION MILL of the Consolidated Mining & Smelting Co. of Canada, a continuous pulp density indicator is in use for quickly showing to the operator the approximate density of the pulp. This ingenious instrument, which was described under Useful Operating Ideas in *Mining Journal-Press* of Jan. 24, 1925, on page 170, has proved to be valuable in obtaining better control of the flotation work. We understand that the device was first used and developed at the Homestake mill at Lead, S. D., from which the idea was carried to Canada by one of the Colorado Iron Works' engineers.

A pulp density indicator of similar design would prove useful in oil-well work as a means for detecting changes in the density of the mud fluid which is circulated during the drilling of a well where rotary tools are employed. At present it is the practice to take samples of the mud flow at intervals and determine the density by weighing a known volume. It is evident that changes in mud density produced by the cutting of a water-bearing stratum could not be detected in this way unless the sample had been taken at the critical time. However, by the use of the continuous indicator, the difference in the working of the mud pump could be quickly checked by the reading of the indicator. Drillers rely upon the variations in the speed of the mud pump as well as upon the appearance of the mud flow to warn them of formation changes. The density indicator would be an additional guard in a situation which requires painstaking care and close observation.

Mining Engineers of Note

Stephen Birch

THE MOST SIGNIFICANT DIFFERENCE between the position of the Kennecott Copper Corporation, the world's largest miner of copper, and its nearest competitor is this: the properties of the competitor and its subsidiaries are mortgaged for about $250,000,000, whereas Kennecott and its associated companies are thus encumbered only to the extent of about $10,000,000. True, the competitor has sundry profitable outside interests, but a complete analysis, recently made, shows that in the single item of "debt service" its production cost per pound of copper is a little more than 3c. greater than Kennecott's. For this there are many and varied reasons; not the least among them is the canniness (we use the term in the best sense) that Stephen Birch, president of the company, has inherited from Scotch ancestors of generations gone by. Although the Kennecott company now controls Braden, Utah, Nevada Consolidated, and Mother Lode, with a potential copper production of about 600,000,000 lb. per year, it is with the Kennecott mines, in Alaska, that the career of Mr. Birch is most closely connected. Kennecott, as he says, is his "baby." Here, briefly, is the story: Following the Klondike gold rush in 1896, Alaska became the hunting ground for genuine prospectors from everywhere. A party of ten, headed by R. F. McClellan, who had heard from trappers of copper deposits in the Copper River country, journeyed inland from Valdez in search of gold and copper. To a member of this party, one Jack Smith, known everywhere as the "Arizona Centipede," fate allotted the honor of discovering the Bonanza mine, without doubt the richest large deposit of copper ever worked. Meanwhile, Mr. Birch, as a twenty-five-year-old engineer, not long graduated from the Columbia School of Mines, had joined the argonauts. Though a native of New York City, and brought up in an environment that is not supposed to put iron in men's blood, Mr. Birch felt strongly the call of the frontier. He proved to be amply able to take care of himself among the none too gentle pioneers of the North Country. He met McClellan and Smith in Valdez in the fall of 1920. The latter told him of a copper deposit which looked from a distance just like a "green sheep pasture in Ireland, when the sun was shining." The hillside was barren; the green was from the copper minerals. The spring of 1921 found Mr. Birch walking 200 miles over two mountain ranges, one 15,000 ft. high, to see this "pasture." Frequently when a fellow golfer today grumbles about the strenuous journey as the clubhouse is approached, Mr. Birch may be observed to smile elusively and reminiscently; but, he avers, he never says anything. Well, he bonded the Bonanza and had a large adjacent area staked in behalf of himself and his associates, H. O. Havemeyer, Norman Schultz, and H. O. Ralph. Copper there certainly was, but there was also that 200-mile haul across two mountain ranges for inbound machinery and supplies and for outbound copper. He came to New York and induced J. P. Morgan and the Guggenheims to put up twenty-odd million dollars to build the Copper River & Northwestern R.R. and to develop and equip the mines. The railroad was built and production started in 1911. Later concentrators and a leaching plant were built. Not only as an executive but as an engineer Mr. Birch has been the guiding genius of the enterprise. He is a director of a number of large corporations aside from those connected with mining, and is a member of a long list of clubs. He could if he desired have a big suite of rooms for his private offices, with luxurious finishings and ornate furnishings, and with a few tapestries and oil paintings for embellishment. Some do. As a matter of fact, he has a very modest office; on the walls are several small framed photographs. J. P. Morgan, the elder, and Daniel Guggenheim are among them, but their pictures are no more prominent than those of numerous others whose place in the public eye is far less conspicuous; as friends of Mr. Birch all are on a par. The room manifestly is designed to afford a place for the efficient transaction of business, not to impress the caller. It reflects the simplicity and sincerity of Stephen Birch.

STEPHEN BIRCH

The Tacoma Copper Smelter and Refinery

Unusual Ore-weighing and Conveyor System — Unloading of Ore Ships — Reverberatory and Blast-furnace Smelting — Electrolytic Copper Refining — Copper-casting Equipment

By George J. Young
Associate Editor, *Mining Journal-Press*

THE TACOMA SMELTER of the American Smelting & Refining Co. occupies a fifty-two-acre site at Point Defiance, on Puget Sound, 6 miles from Tacoma, Wash. The smelter has a strategic position at tidewater on an excellent harbor contiguous to fuel and power. Although no mining districts are in the immediate vicinity, Alaska, British Columbia, Washington, and the west coast of the Americas, generally, afford sources of shipping ores.

The enterprise was originally started by W. R. Rust as a lead smelter. Great credit is due Mr. Rust for his pioneer effort and for his foresight in anticipating the industrial possibilities of the Puget Sound region. In 1898 F. W. Bradley and his associates bought a third interest in the Tacoma Smelting Co. for the Bunker Hill company, and an equal interest for the Alaska Treadwell companies. The remainder was held by W. R. Rust and others. The ore supply that was thus assured brought prosperity to the smelting company, and in addition to the payment of dividends the plant was rehabilitated and greatly improved. A copper-smelting department was added to the lead-smelting department, and a copper refinery was constructed in 1903. At the time, L. J. W. Jones was superintendent of the lead department and B. H. Bennetts was superintendent of the copper department. Rust was manager. The Selby Smelting Co. refined the lead bullion from the Tacoma plant, and thus the two coast plants became more or less interdependent.

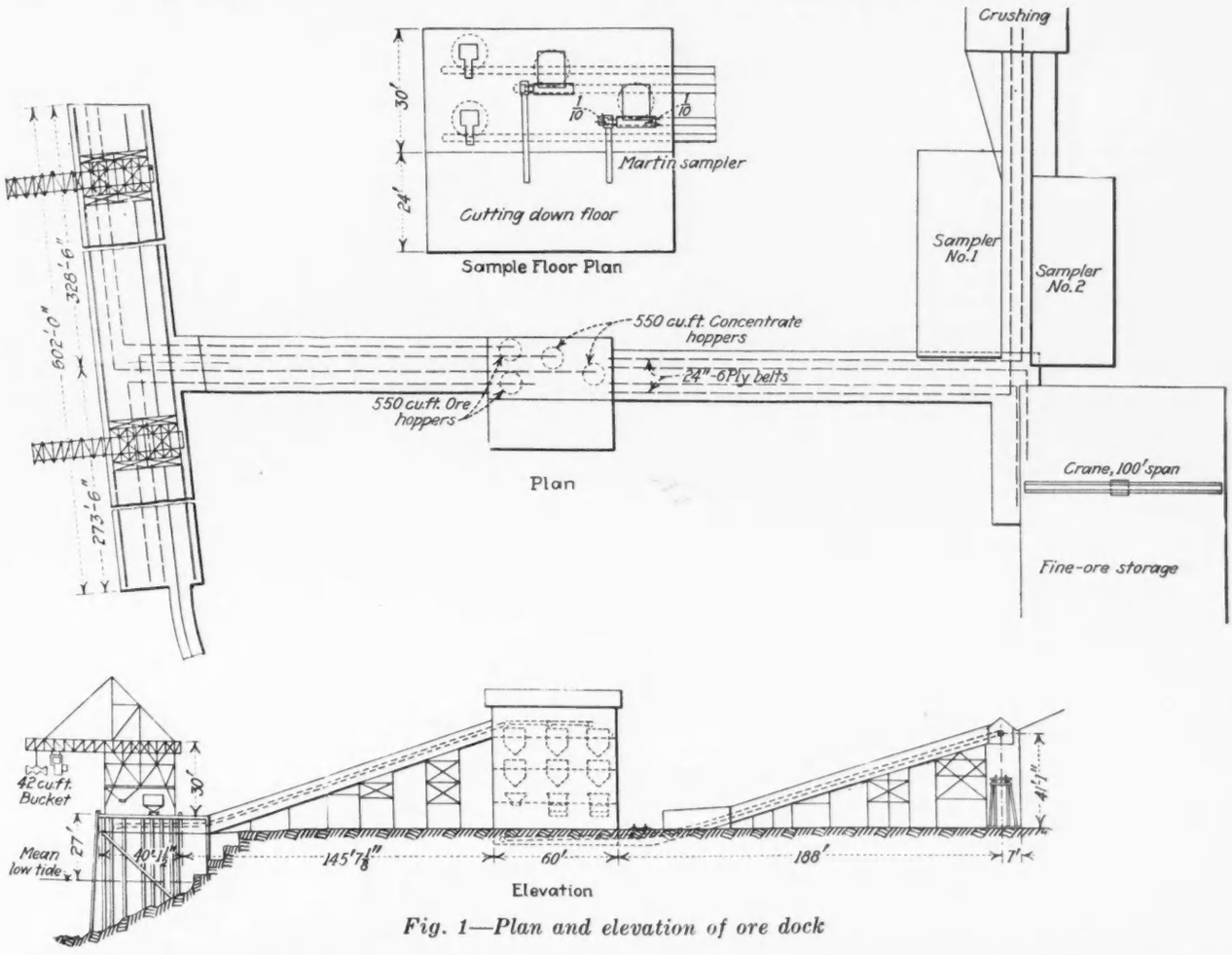
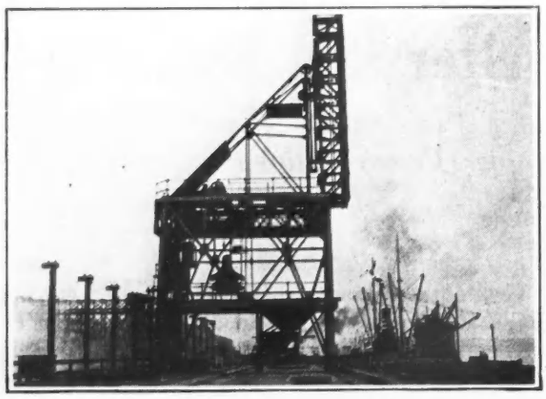


Fig. 1—Plan and elevation of ore dock

The prosperous condition of the two companies attracted the attention of the Guggenheims, and negotiations were opened in 1904 for the purchase of both Tacoma and Selby. They were acquired in 1905 and operated by a holding company known as the American Smelters Securities Co. Early in 1923 this company was dissolved and the American Smelting & Refining Co. assumed ownership. Lead smelting was discontinued, and the custom operations were restricted to gold, silver, and copper ores and copper refining. The principal ore sources are the copper ores and concen-



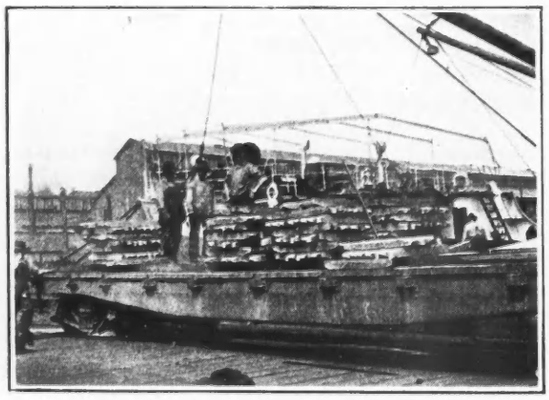
One of the two unloading cranes at the new ore dock

trates from Kennecott, Alaska, copper concentrates from Britannia Beach, B. C., silver-gold ores from the Premier mine, in the Portland Canal district, and miscellaneous copper, gold, and silver ores from South America and other points. California supplies a regular tonnage of low-grade basic copper ore. The major products are electrolytic copper, doré bullion, arsenic, and liquid sulphur dioxide.

Under the management of H. Y. Walker the plant was brought to its present efficient condition. R. F. Barker is now in charge as superintendent, E. A. White is assistant superintendent; B. A. Berryman in charge of smelting operations; W. H. Morrison in charge of refinery operations; and H. W. Keil, plant engineer. The smelting capacity of the plant is 2,500 tons per day, from 700 to 900 men being employed.

The designs of the new ore-unloading dock were developed as a result of experience with several different methods of handling ore shipments from the ship's hold to the smelter bins. No one method had proved satisfactory, and as a consequence a comprehensive plan designed to reduce labor to a minimum was carefully worked out. A new dock (see Fig. 1) was constructed in the vicinity of the old dock. The general plan provided space for several vessels to be lined up at the wharf and to be unloaded simultaneously. The old docks are now utilized for loading copper and other products on outgoing vessels, so that outgoing and incoming shipments are segregated.

On the new dock, two lines of 24-in. belt conveyors are arranged on the long axis. These are placed below the floor of the dock and are on both sides of four lines of 24-in. inclined belt conveyors that discharge into hoppers in the weighing house. The inclined conveyors are at right angles to the dock conveyors, which latter can be adjusted so as to discharge upon any one of the inclined conveyors. Access to the dock conveyors at any point along their length is obtained by lifting sections of the dock flooring.



Outgoing copper

Two ore-unloading cranes are provided. The cantilever arm of the crane is hinged and can be lifted out of the way when ships are being docked. When lowered into operating position it provides a horizontal runway for the bucket carriage. A Brownhoist ore bucket is used for bulk unloading from vessels and barges, the bucket discharging into a hopper which is a part of the crane. An apron-plate feeder delivers the ore to a spout which can be adjusted to serve either conveyor line. The crane is power driven and travels upon rails extending the length of the dock. Where shipments of ore in sacks are to be handled, the bucket is removed and the sacks of ore are hoisted out in slings and placed upon tables on the dock, where they are opened and their contents emptied upon the belt conveyor. Ore can also be discharged into railroad cars, a railroad spur extending under the craneway being available.

The ore-unloading problem can be appreciated best by consideration of the fact that many different cargo boats deliver ore both in bulk and in sacks. Hatchways have not been standardized, and vary in size and position, and the unloading rigs must be elastic enough in arrangement to permit handling any kind of ore cargo out of any kind of vessel. The new dock has met this situation as well as the problem can be solved.

The dock conveyors are carried on angle irons to permit rectifying their alignment from time to time. Spillage is caught by benches arranged under the belts. The shuttle conveyors are carried on steel frames supported on wheels and a track. The inclined conveyors carry the ore streams to the weighing house, where four pairs of forty-ton capacity steel hoppers are provided, two for receiving lump ore and two for concentrates. In each pair, one hopper is placed above the other, the upper hopper being the receiving hopper and the lower the weighing hopper. The upper coarse-ore hopper is closed by a horizontal gate that travels on wheels supported on a track, the gate being opened and closed by wire ropes and a motor-driven winch. The method of operation is simple and the handling of the ore stream is practically continuous. After the upper hopper is filled, the gate is opened, discharging the contents into the weighing hopper beneath. Then, after closing the gate, the stream of ore continues to be discharged into the upper hopper. The lower hopper is provided with sixty-ton Fairbanks-Morse recording scales; and, after weighing, the contents are discharged upon a belt feeder that in turn discharges upon a conveyor leading to the coarse-ore samplers. The discharge gate of the lower hopper is of the arc type. Standard weights are arranged upon a beam on the supporting framework of the weighing hopper so as to be readily available for scale calibration.

The receiving hopper for the concentrates is provided with hinged gates that can be opened to the full section of the hopper. These are controlled by bolsters that bear against the gates and are moved back and forth by screws operated by a motor. The weighing hopper beneath discharges into a small hopper and this in turn to a wide rubber belt feeding a Martin sampler, which is equipped to handle sticky flotation concentrates

when necessary. The sample cut is fed to another Martin sampler and reduced in volume, the reject from both samplers being discharged to a belt conveyor that removes the concentrate to the storage bins. The sample of concentrates is received in a separate sampling room alongside of the weighing house, where moisture and assay samples are prepared. Two separate ore lots and two lots of concentrates can be handled simultaneously through the weighing house and samplers when necessary.[1]

Both coarse-ore sampling mills are designed upon the principle of cutting the whole of the ore stream at intervals and the progressive reduction of the particle size. The newer sampler, No. 2, shown in Fig. 2, is an improvement in design over the older plant and will be described in detail. The ore is received by the conveyor system from the weigh house into a bin and is fed to a Traylor jaw crusher, which discharges upon an inclined belt conveyor. This discharges into a Vezin sampler (No. 1). The sample is sent through a rock breaker to an inclined conveyor, which discharges into a small bin above No. 1 rolls. A feeder is interposed between the bin and the rolls. The product from the rolls is carried by a conveyor to No. 2 Vezin, the sample to another conveyor, No. 3, delivering to No. 2 rolls. No. 4 conveyor receives the discharge of No. 2 rolls and discharges into No. 3 Vezin, the sample being received upon No. 5 conveyor, which delivers to a bin, feeder, and No. 3 rolls. The product from No. 3 rolls is received in a small car and is ready for final reduction for assay and moisture samples. All Vezin sample cutters are arranged on one side, their rejects being received on the same conveyor. The rolls are lined up on the opposite side. Nos. 1, 3, and 5 conveyors parallel each other and the building line and travel in the same direction, delivering to the rolls. No. 2 and No. 4 conveyors are at an angle to the building line and return the roll products to No. 2 and No. 3 Vezin samplers. The arrangement avoids the use of bucket elevators and enables the principal units to be placed upon a common ground floor. All of the parts are accessible

[1]The Martin sampler, invented by F. M. Martin, was developed at the Garfield smelter and is described in detail in *Mining and Scientific Press*, vol. 122, p. 17, Jan. 1, 1921.

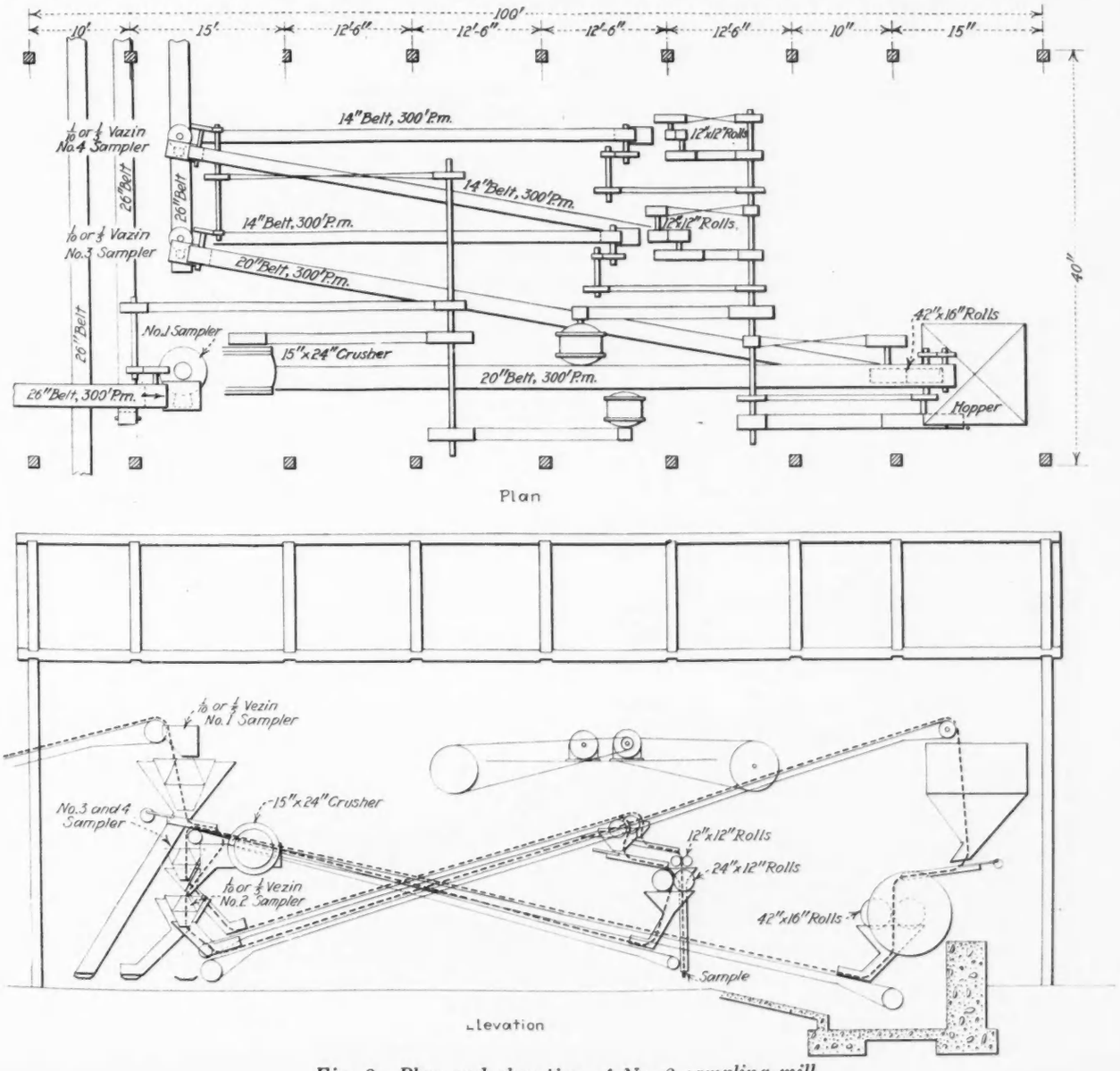


Fig. 2—Plan and elevation of No. 2 sampling mill

for cleaning, and individual housings reduce the dust, though an exhaust system for removing all of the dust is not included in the design. The accompanying sketch, Fig. 2, will help to make the arrangement clear.

The reject conveyor delivers its product to the smelter bins or to an impact screen, which sends an oversize to a set of rolls delivering to a bucket elevator which returns the crushed product to the screen. The undersize is sent by the conveyor system to the fine-ore bins. The screen size is $\frac{3}{8}$ in.

Coarse-ore storage is provided for by forty-two bins, each of about 500 tons' capacity, varying with the character of ore. The bins are hopper bottomed and discharge into weighing hoppers which in turn empty into the charge cars. Side-tipping cars of the rocker type hauled by trolley locomotives are used to charge the blast furnaces.

Fine-ore storage is provided in a separate building which covers a series of floor bins and is served by a 100-ft. craneway. The fine ore and concentrates are brought by conveyor belt to a shuttle conveyor which discharges at the receiving end of the building. A traveling crane distributes the ore in the various bins, a Brownhoist ore bucket being used for handling the ore. Reverberatory furnace charges are made up by measuring the different components of the charge by means of the ore bucket which is discharged into a stationary hopper placed between the bins. The ore charge is conveyed by a belt to the roasting furnaces.

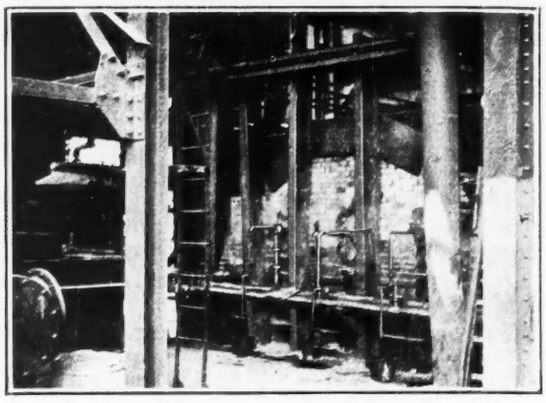
A wire-rope tramway is part of the ore-handling equipment and is now used for stockpiling ore in the smelter yard whenever that is necessary. A system of standard-gage tracks permits of the discharge of railroad cars into the fine-ore or into the coarse-ore bins.

The division of the ore supply first into concentrates and fines and then into crude coarse ore also sharply divides smelting into two kinds, reverberatory and blast furnace. The roasting equipment consists of six furnaces of the Herreshoff type. These are 19 ft. 6 in. in diameter and are provided with six hearths (1,365 sq.ft. area) and a drying table. Oil fuel is used. Charges are roasted down to 15 per cent sulphur, approximately seven units of sulphur being removed in roasting. The calcine is received into an open-top charge car and after weighing on track scales is sent to

Fine-ore storage bins

the reverberatory furnace. The feed to the roasting furnaces is $\frac{1}{2}$ in. maximum size and the roasting rate averages 137 tons per furnace per day. The maximum roasting rate obtained has been 190 tons per furnace.

The single reverberatory was constructed in 1916. To date the bottom and side walls have not been repaired and are in excellent condition. The furnace has been operated 95 per cent of the time since it was built. It is $23\frac{1}{2}$ ft. by 130 ft., inside dimensions (2,866 sq.ft.). The excessive length was provided to insure a



Copper-melting reverberatory; firing end

large storage space for matte and it has proved suitable for the operating conditions of the plant. Two 500-hp. waste-heat boilers are provided. Pulverized coal is principally used, although oil fuel can also be used. Four fishtail burners serve the furnace. Coal dust is fed by screw feeders from hoppers on either side and blown into the furnace, an auxiliary air supply being provided at each burner, and the coal brought by worm conveyors to the hoppers at the furnace from the coal-pulverizing plant. Calcines are fed to the furnace from hoppers on either side, extending for a distance of 60 ft. from the burner end, though the greater part of the feed is introduced in the first 40 ft. Matte is drawn out near the front of the furnace. The slag is removed at intervals and handled in ladle cars; it is useful in extending the smelter yard.

Three blast furnaces, two 48 in. by $21\frac{3}{4}$ ft. and one 42 in. by $21\frac{3}{4}$ ft., are arranged in a line facing the converter aisle. Forehearths are provided on the side of each furnace, and matte is discharged into pots in the converter aisle, which is served by a traveling crane.

The blast furnaces average 600 tons of charge per day. The reverberatory handles 700 to 800 tons of highly siliceous charge and coarse siliceous ore. The blast-furnace ore column is maintained at approximately 12 ft. The matte averages 45 to 50 per cent copper, the charge 10.5 per cent sulphur. From 32 to 34 oz. pressure is used on the blast. The reverberatory matte averages 35 per cent copper, and ranges up to 50 per cent. The slag composition ranges from 38 to 43 per cent silica and 7 to 8 per cent lime.

Four converters are available for the treatment of copper matte. All are of the Peirce-Smith basic-lined type and are provided with the Tacoma hood, which originated at this plant. Two are 13 by 30 ft., one is 11 by 26 ft., and the other 10 by 26 ft. The capacity of the large converter is 180 tons of copper per twenty-four-hour day, and linings average 20,000 tons of copper. The converter slag is poured into the reverberatory, though a circular slag-casting machine is available for use when necessary. The blister copper is cast directly into anodes by Walker casting machines, receiving the copper from 150-ton oil-fired revolving furnaces (basic-lined hearth with silica-brick roof).

Three casting machines are available. A 75-ft. craneway serves the converter aisle.

The waste gases of the roasting furnaces and reverberatory discharge into a brick header flue, which connects to two brick flues that join in a common flue leading to the stack, a bypass connecting both flues to the Cottrell treater. The blast furnaces are connected to the treater by an independent flue. The treater is connected by a brick flue to the opposite side of the stack. The converter gases are carried by a steel flue that connects to the reverberatory flue. The Cottrell treater consists of 18 independent units in parallel, each of a capacity of 640,000 cu.ft. per minute, a motor generator and accessory equipment being provided for each two units. Each treater unit is made up of 84 pipes 12 in. by 15 ft., a total of 1,512 pipes. The gases pass downward to the flue leading to the stack. The flue dust is treated in the reverberatory. The stack temperature averages 130 deg. C., and no humidification is used on the gases. The treater current ranges from 56,000 to 60,000 volts, and the maximum power input is 175 hp. Nine electrical sets are operated in regular service and one extra unit is maintained as a spare.

The World's Tallest Stack

The stack is 572 ft. 10 in. above datum (top of foundation block), the top diameter being 24 ft. and the bottom diameter 40 ft. The foundation consists of a concrete block containing 5,000 cu.yd. of concrete reinforced by 120 tons of 60-lb. rails. Paving brick (4 by 3.5 by 8.5 in.) form the wall of the stack, the inner lining, 4.5 in. thick, being separated from the stack wall by a 2-in. air space. Expansion joints are placed at regular intervals, where the inner lining terminates for a short interval. At these levels the stack wall is continuously corbeled and the next section of lining is supported on the corbel. A lead sheet closes the space between the corbel ring and the upper edge of the lower section of lining; this lead sheet is bent and the 4-in. horizontal upper edge is held by the wall brick of the corbel.

The arsenic plant, contiguous to the roaster flue, is equipped with a Godfrey roasting furnace, a small reverberatory for refining the first arsenic product, and three flues for condensing. Its capacity is from 250 to 260 tons of arsenic per month. Barreling equipment is provided.

The sulphur dioxide plant is alongside of the converter flue and takes its gas supply from this flue. The sulphur dioxide is separated from the other flue gases by absorption towers. The gas liquor is sent to a pre-heater, which is heated by hot liquor from the boiling tanks to which the liquor is sent and boiled with steam. The sulphur dioxide gas is cooled and dried over sulphuric acid and then liquefied by compression. The plant produces 20 tons of liquid sulphur dioxide per day and is operated intermittently.

Three tank houses are provided for the electrolytic copper refining, which is an important part of the work of the Tacoma smelter. No. 2 house was built in 1916 and No. 3 in 1917. The aggregate capacity is 8,500 tons per month. All three tank houses are in close proximity to the power house and are served by industrial tracks which deliver anodes on the basement floors below the tank floor and cathode sheets to the melting house. Storage-battery locomotives are used for this service. The buildings are constructed with wooden trusses, columns, and floors. Walls are of hollow tile. No. 1 and No. 2 tank houses are each equipped with two cranes and No. 3 with one twelve-ton traveling crane.

No. 1 tank house contains 466 tanks, of which 146 are used in the preparation of starting sheets and 320 for commercial copper. These tanks are 2 ft. 9 in. by 8 ft. 3 in. by 3 ft. 8 in., and each contains 21 anodes and 22 cathodes. No 2 house contains 480 tanks, each 2 ft. 9 in. by 12 ft. 4 in. by 3 ft. 10¼ in. The anodes per tank number 32 and the cathodes 33. No. 3 house contains 240 tanks, each 2 ft. 9 in. by 14 ft. 8 in. by 3 ft. 10¼ in., with 38 anodes and 39 cathodes per tank. The tanks total 1,186. All tanks are lined with lead and are constructed of fir and painted upon the outside with asphalt paint. Anodes are 28 by 37 by 1½ in. in size and weigh about 480 lb.

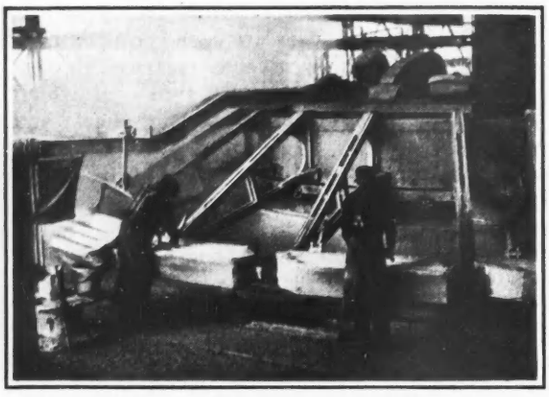
A copper sheet 29 by 38 in. is used as a starting sheet. These sheets are made at one end of No. 1 tank house. The tanks allotted to starting sheets are loaded with copper blanks that have been put through an automatic greasing machine, which has been developed in this plant. This device picks up the sheets, one at a time, immerses them in the oil tank, draws them up between two rubber-covered rollers that wipe off the surplus oil, and places them on a loading rack from which the crane picks them up a tankful at a time.

After twenty-four hours the blanks are taken from the tanks by the crane and hung on a skinning rack, where the sheets are stripped off. Two loops are then attached to the end of each sheet by a loop machine placed adjacent to the skinning rack. Hanger bars are then put through these loops, the sheets straightened on a block and hung in the commercial tanks. After twenty-four hours they are again straightened on a block and replaced in the tanks. The average weight of the commercial cathode is 140 lb.

The electrodes in the tanks are arranged in multiple, with the tanks in series. The Whitehead contact is used between anodes and connecting bars. In No. 1 house, 16 tanks are arranged as a section, and in No. 2 house and No. 3 house 20 tanks constitute a section, which is the unit for working purposes.

Power is supplied by three groups of motor generators: No. 1 house is served by three generators, each 150 volts and 2,000 amperes; No. 2 house by two generators, each 150 volts and 5,000 amperes; and No. 3 house by two generators, each 185 volts and 6,000 amperes. The current density is usually about 18 amperes per square foot of cathode area, but this varies with the rate of production, ranging as low as 12 amperes and sometimes exceeding 18 amperes. Current efficiency averages 93.6 per cent, but this also depends upon rate of production.

The electrolyte is maintained at 130 to 135 deg. F by heating with exhaust steam. It contains 40 gm. of copper, 160 gm. of sulphuric acid, and 20 gm. of nickel per liter. The electrolyte in the starting sheet tanks contains 125 gm. of acid per liter. The electrolyte is carried to the bottom of each tank by a partition and overflows by a lead pipe at the end of the tank. This pipe is separated from the lead-pipe return system by a short porcelain tube, which serves as an insulator. Each tank is provided with a separate feed. The solutions are handled by gravity and are pumped by the lead-lined centrifugals to the supply tanks. A mud launder system and sump tanks are provided. Spent electrolyte is sent to a separate building, where the cop-



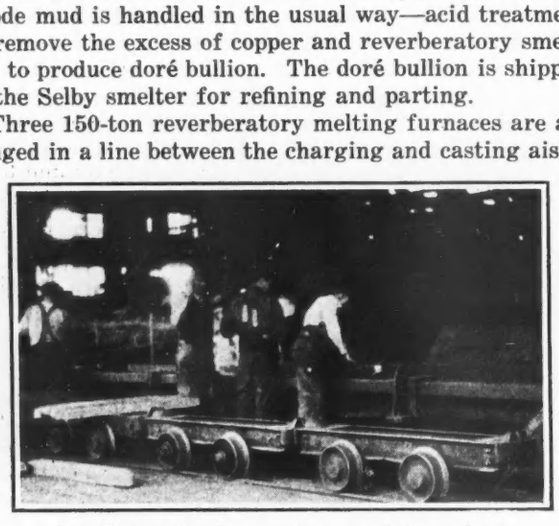
The casting machine, copper-melting plant

per is removed electrolytically by lead and the arsenic and antimony are next removed by lead electrodes which are scraped to remove the black deposit of these metals. The electrolyte is then evaporated in two tanks heated by steam coils and is further evaporated to 60 deg. Bé. density in iron pans heated by oil burners. Nickel sulphate, being insoluble in concentrated sulphuric acid, is precipitated as a fine sludge. The sludge is washed and dried in a centrifugal and the acid returned to the tank house. The recovered nickel sulphate is shipped to the Baltimore plant of the company.

Three cathodes are pulled for each anode. The intervals are seven, nine, and nine days. The average totals twenty-five days, depending upon current density. Anode scrap amounts to 14 to 16 per cent of anode weight. The cathodes are lifted and placed in a special washing box which was developed at this plant. They are drawn through a spray that removes the adhering electrolyte and are then piled flat on special cars for transportation to the melting furnaces.

Anodes vary in precious-metal content from 80 to 200 oz. doré bullion per ton. The outturn of doré bullion is from 600,000 to 900,000 oz. per month. The anode mud is handled in the usual way—acid treatment to remove the excess of copper and reverberatory smelting to produce doré bullion. The doré bullion is shipped to the Selby smelter for refining and parting.

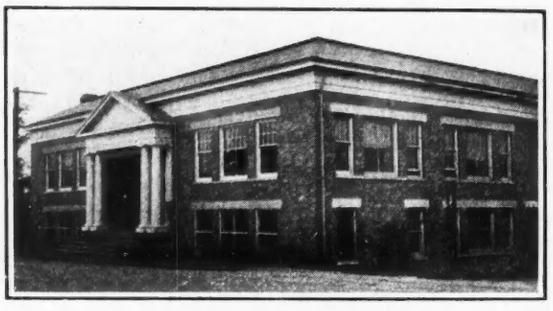
Three 150-ton reverberatory melting furnaces are arranged in a line between the charging and casting aisles



Loading wire bars, copper-melting plant

of the melting plant. The furnaces are oil fired at one end and at the opposite end is an opening for poling the copper. Two side doors are used for charging, done by a Morgan charger carried upon a traveling crane. Three circular casting machines are placed in front of the furnaces. Each carries a series of copper molds, which are sprayed with a bone-ash wash by compressed-air nozzles as they approach the pouring spout. A multiple pouring spout distributes the molten copper in six streams to the mold. Three wire bars are cast simultaneously. The molds are overturned at the discharge point and the copper bars quenched in a tank, from which they are automatically removed.

A 150-ton coal-pulverizing plant equipped with Raymond grinders prepares the fuel for the reverberatory smelting furnace. The waste-heat boilers of the reverberatory supply 1,100 hp. Electric power purchased from hydro-electric companies is stepped down from 40,000 volts, a total of 8,000 hp. being required by the plant. Fuel oil supplied by tank steamer is used in the copper-melting furnaces. A machine shop, foundry, plate, and blacksmith shops and laboratories are a part of the general equipment. The power house provides for direct current for the electrolytic tank houses, direct current at 240 volts for the trolley locomotive service, and 440 volts alternating current for blast-furnace air, converter air, and compressed air. Blast-furnace air is supplied by two No. 11 Roots blowers belted to 300-hp. motors. Converter air is supplied by three blowing engines, one a cross-compound steam-driven Nordberg of 18,000 cu.ft. capacity, one a motor-



Clubhouse and gymnasium

driven Nordberg of 11,000 cu.ft. capacity, and an Allis-Chalmers blowing engine of 6,000 cu.ft. capacity. In addition, a motor-driven rotary blower of 30,000 cu.ft. capacity is available. High-pressure air at 110 lb. is supplied by a cross-compound Nordberg steam-driven compressor and a motor-driven Sullivan compressor of the duplex direct-driven type. Three motor generators supply 240 volt current.

The unique features of the Tacoma smelter reflect great credit upon the engineering staff, which has consistently improved equipment and operating procedure as the need for this developed. The system of ore weighing prevents errors. Thorough sampling facilities provide accurate samples and maintain the good repute of the plant in the custom business. A good system of accident prevention, the basis of which is the making of the foremen responsible for safety, has resulted in a low accident ratio. Safe travel routes have been established. In addition, excellent facilities for the comfort and convenience of workmen have been provided. A flue system, Cottrell treater, and a stack that is one of the highest in use at any smelter, remove the smoke nuisance and reduce metallurgical losses. Excellent supervision and close plant control are apparent. Good mechanical engineering is a feature.

The plant was visited twice, and on both occasions I was cordially received, and take pleasure here in acknowledging the courtesy of the plant officials.

Reclosing Equipment for Mines

A Discussion of the Characteristics and Design of the Various Types in Use

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E. L. Hough

AUTOMATIC reclosing equipments are continually finding wider use in the mining industry, and their proper application provides a means of increasing mine output and of effecting economies not fully appreciated by the industry at large. Several types of reclosing equipment are at present available. Their costs vary with the manufacturers. It is wise to consider not only first cost but other factors also, such as accuracy and ease of adjustment, ruggedness and reliability of the devices used, freedom from coil or resistor burn-outs, line-up with present control panels, cost of installation labor, effect of line voltage variation on reclosing, adaptability to different operating conditions, performance of equipment that has been in service for some time, and the like. It is the purpose of this article to discuss the characteristics and designs of reclosing equipment with a view to aiding those responsible for the selection of such equipment at mine plants to choose the proper device to meet existing operating conditions.

The application of electrical equipment to mining has effected large savings in mining costs, besides increasing production materially and making improvements in working conditions possible that were scarcely dreamed of years ago. As designs were improved, it was natural that thought should be given to the reduction of operating costs of electrical equipment, particularly to reducing the expense of operating power stations and substations. Economy in power transmission required the placing of generating or converting units as near the load as possible. But it was necessary to locate the station at a point remote from its load and to make use of long runs of expensive feeder copper in order that coal and water might be readily accessible for the direct-current steam station.

The tendency at present is toward the use of power purchased as high-tension alternating current from central stations, where large units and efficient plants make possible the sale of power at a figure usually below that at which the mining company can produce it. If high-tension power is not available, it becomes necessary, as mines grow in size, for the mining company to generate its own power as alternating current in order to transmit it economically to the load. Whether the power be purchased or generated as alternating current, it is necessary to interpose a station for converting the alternating current to direct current for use in the mine, either rotary converters or motor-generator sets being used, as determined by local conditions.

The expense for attendance is commonly a large part of the total cost of power furnished by such manually operated substations, and difficulty is often experienced in times of labor trouble because of union affiliations of substation operators or by their sympathy for the union. It is also difficult to secure efficient operators at any price, and the cost of equipment maintenance is unusually high and the service poor because of the lack of ability or carelessness of the operator.

The mining industry, taking advantage of the lesson which had been learned by the electric railways, was quick to adopt the automatic substation as a means of providing better and more continuous service at a lower cost and with greater freedom from labor trouble. At present the slogan seems to be "Make every new station an automatic," and, as fast as conditions permit, the manually operated stations are being made over for automatic or partly automatic control. The design of automatic station equipment has been standardized to such an extent that it is possible for the manufacturer to stock complete substation equipment.

The original design of the fully automatic station required that some means be provided for the reconnection of a feeder to the bus, or of the machine to its load, after the circuit breaker had been opened by an overload or short circuit. The first automatic substations were equipped with a type of reclosing feeder known as the "load limiting feeder," which had proved its worth in railway service. It was soon found, however, that such an equipment did not meet fully the requirements of the mining field, because, as will be pointed out later, this is primarily a "multiple-feed" method of operation. The "load-indicating" reclosing feeder equipment was, therefore, developed to fit the conditions of mining service, and the numerous installations that have been made testify to the correctness of the design.

Three Classes of Application for Automatic Equipment

Progressive mining companies are installing automatic reclosing equipments in their attended substations to increase the efficiency of the electrical service. It is possible, by the addition of a few simple protective devices such as bearing temperature relays, reverse power relays, and the like, to convert a manually operated station into a partially automatic one. There are, therefore, three classes of application for automatic reclosing equipment; that is, (1) automatic stations, (2) partial automatic stations, and (3) feeder circuits in manually operated stations. The installation of such equipment has been made under so wide a variety of conditions that manufacturers are now in a position to make definite recommendations for any application. A typical installation of automatic reclos-

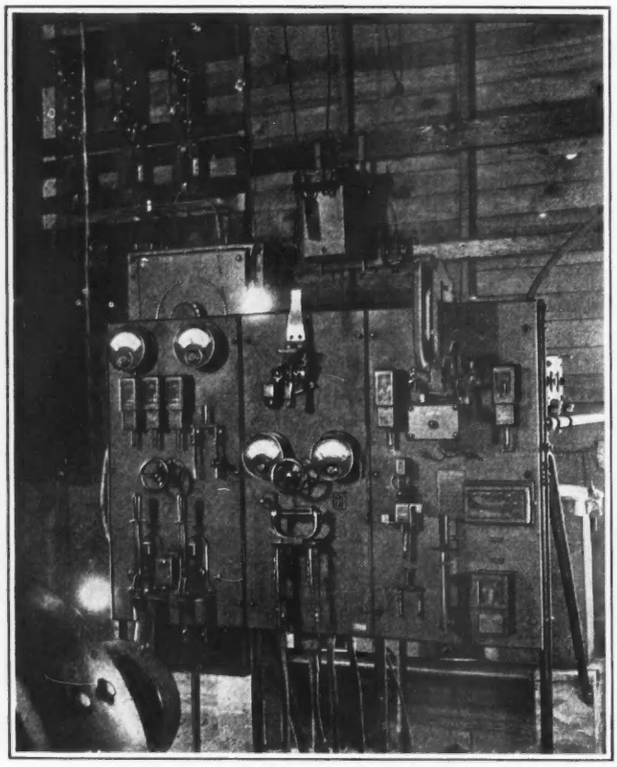


Fig. 1—Automatic reclosing feeder equipment installed in a manually operated substation

ing equipment in a manually operated station is shown in Fig. 1.

When feeder circuit breakers are reclosed manually, an operator has no way of knowing the external circuit conditions before closing the breakers. It is, therefore, necessary for him to close in on the "short," with a resultant strain on the entire system and particularly on the substation equipment. It is often extremely difficult to secure intelligent and careful operators. Thus the employment of poor operators introduces still another hazard to service and equipment. Automatic reclosing equipments are available to perform the exact service required with a minimum time delay and with no damage to substation equipment.

Another point to be considered seriously is the reduction of the time during which service is interrupted when automatic equipment is used on the feeder circuits. Keeping power on the trolley but a few additional minutes during the working period each day is directly reflected in the output of the mine—more power, more product.

By making it unnecessary to station an operator at a point where switching is to be done, the automatic reclosing equipment makes possible a more economical arrangement of feeder copper, with a consequent reduction in distribution losses.

Briefly stated, automatic reclosing equipment makes it possible to increase the mine output without additional power equipment in the following ways:

1. By insuring continuity of power under normal conditions.

2. By giving reliable, continuous protection of the apparatus in case of a disturbance on the feeders.

3. By avoiding delays and mistakes incident to manual reconnection of power.

4. By making possible the more economical division of feeder copper, with consequent service improvement.

Two classes of service are commonly recognized in mining feeders, and a single feeder may come under either classification, depending upon the method of connecting machines to the mining network and the method of sectionalizing the network. When a single power source feeds a load, the feeder is called a "stub-end feeder." Such a condition is illustrated by Fig. 2. When two or more independent power sources are connected to a common load, the feeders are known as "multiple feeders." This is illustrated by Fig. 3.

In mining work it is common practice to have several machines serving a mine during the day and to allow only one machine to run through the night for supplying pumps, lights, and other apparatus. It is apparent that a single feeder may thus be called upon to operate under either stub end or multiple feed conditions. Such a feeder is known as a combined stub end and multiple feeder, and is illustrated by *B* in Fig. 3; it will be stub end if machine No. 2 only is running, and multiple if both machines are running. Therefore, any reclosing feeder equipment for such a feeder should be capable of operating under either set of conditions without the necessity for manual changing of relay settings, and should prevent closing on too heavy a load under either condition, so as to avoid successive openings and reclosings, usually known as "pumping."

In general, an automatic reclosing equipment should operate as follows: (1) Trip on overload; (2) reclose after a time delay; (3) reclose on either stub end or multiple feed; (items 1, 2 and 3 should be capable of independent adjustment). (4) The feeder unit should be self-contained and should operate from the circuit controlled independently of any machine or generator circuit, except when the feeder forms a part of the generator circuit. In addition, an equipment for sectionalizing purposes should be capable of taking control voltage from either side of the main circuit interrupting device; that is, it should be capable of reclosing from and measuring the load on either side of the sectionalizing device.

Three Ways of Operating Feeder Reclosing Equipment

The various plans which have been proposed for operating feeder reclosing equipments may be classified under one of three headings: (1) Simulation of manual operation; (2) load limiting or shifting; and (3) load indicating or measuring.

The "simulation of manual operation" plan would, as its name implies, require the use of equipment which would close the power-interrupting device several times and then prevent its reclosure after a predetermined number of operations. This equipment could probably be produced quite cheaply, as the only apparatus required would be a trip-free, solenoid-operated auto-

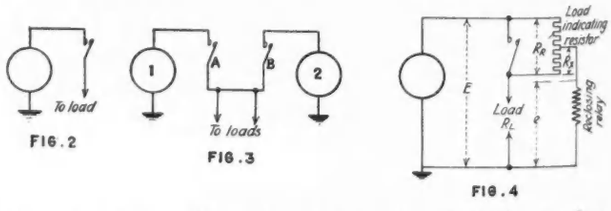


Fig. 2—Stub-end feeders. Fig. 3—Multiple feeders. Fig. 4—Schematic diagram of an automatic reclosing equipment

matic trip circuit breaker, a timing device, and a locking-out counting device. Such a method of operation is, however, open to very serious objections, such as the necessity for manual resetting after a prolonged short circuit and the damage to power apparatus occasioned by the frequent application of a short circuit on the system. It is doubtful if any direct-current reclosing equipments of this type are now in service in the mining field.

The load-limiting or load-shifting method of operation has, as previously mentioned, found a wide application in electric railway service, but has been applied only to a limited extent in mining work. The load-limiting equipment consists of several overload relays and contactors which control the amount of resistance to be inserted between a machine and its load. The insertion of resistance on a multiple feeder causes the load to shift from the overloaded machine to machines further away, and, under such conditions, has a beneficial effect. It is seldom, however, that a mining feeder operates continuously as a multiple feeder, and the insertion of a step of resistance on stub-end feed reduces the voltage at the load by the amount of the drop in the resistor step. The reduced voltage slows down the motors, which in turn tends to increase the period of overload, with resultant power loss in the resistors and the liability of damage to haulage motor armatures. Hence, the use of such resistors on stub-end feed has a detrimental effect, and, in view of the fact that most mine feeders are of the combined stub-end and multiple type, it is doubtful if this type of equipment will ever have more than a limited application to mine installations.

The load limiting or shifting resistance plan is of value in multiple feed work when it may be used to increase the load factor of machines and thereby reduce the rating of the machine required for a given service. This type of feeder has found a wide application in electric railway work, where it is customary to have several machines (multiple feed) connected to the load at all times.

Equipment of Load Indicating or Measuring Type Commonest in Mines

Most of the direct-current reclosing equipment in use in the mines today is of the third class; that is, load indicating or measuring. This equipment has been applied successfully to the measurement of external circuit resistance on stub-end feed, and a method of approximate measurement of load on multiple feed has been developed and has been in successful operation for some time. The method of measuring the external circuit condition on stub-end feed consists in measuring the unknown resistance by means of a known resistance and two voltage readings. A Wheatstone bridge method is also possible, but it is not used to any great extent, because of the difficulty in obtaining the sensitive relay which is necessary for accuracy and which will be strong enough to stand up under severe service conditions. Furthermore, such a method is not readily applicable to a combined stub-end and multiple feeder.

The methods in use for measurement of load on mining feeders are all similar in that a load-indicating resistor is used to allow a measuring current to flow. Different connections of the reclosing relay are possible, however, and a study of the general characteristics of the various types of reclosing equipment brings out some interesting points.

A simple schematic diagram of the connections for a stub-end reclosing equipment is shown in Fig. 4. The voltage of the generating source is designated by E; this value is usually 275 volts in mining installations. The reclosing calibration of the relay is denoted as e, the load resistance by R_L and the load-indicating resistor by R_R. For purposes of discussion, the reclosing relay may be considered as a contact-making voltmeter, and we need not consider its resistance or the current which it takes.

It has been found that the load-indicating resistance should be of such a value that it will allow 2 per cent of full load current to flow when the feeder is short-circuited. Thus, on a 900-ampere feeder the resistor should allow 18 amperes to flow, and would, therefore, on a 275-volt circuit have a value of 15.3 ohms. If a load is drawing 900 amperes on a 275-volt circuit, its resistance is $\frac{275}{900}$, or 0.305 ohms, which is approximately 2 per cent of that of the load-indicating resistor. Therefore, if we are measuring a load resistance which would give 900 amperes on reclosure of the circuit breaker, 2 per cent of the line voltage would be obtained across the load and 98 per cent across the load-indicating resistor. Therefore, if the reclosing relay is connected directly across the load and is set to allow reclosure of the breaker at 900 amperes, the calibration point, e, of the relay, should be 2 per cent of 275 volts, or approximately 5.4 volts. Similarly, if the relay is set to pick up one-half load (450 amperes) R_L, the load resistance would have to be $\frac{275}{900}$, or 0.61 ohms, which is 4 per cent of the resistance of R_R. The relay would then be set to pick up at 10.8 volts.

In general, the higher the voltage available for the operation of the relay, the easier it is to design a simple and cheap relay. It is possible to increase the voltage on the relay by utilizing some of the voltage drop across the load-indicating resistor. It can be seen that there must be some value that gives the best operation, and calculations show that, to produce any appreciable difference in this manner, a combination is obtained which, with variations in trolley voltage, gives a wide variation in current obtained on reclosure.

If the coil of the reclosing relay is connected so as to obtain the voltage drop through R_x ohms in addition to that through R_L ohms of the load, as shown in Fig. 4, it can be shown that e, the calibration point of the reclosing relay, has the following relation to the other variables under consideration:

$$e = \frac{E(R_x - R_L)}{R_r - R_L} \qquad \text{(Equation 1)}$$

To derive values of e for this and following examples, actual values for a 900-ampere feeder equipment are taken as follows:

E (the line voltage) = 275 volts
R_L (the load resistance) = 0.305 ohms.
R_R (the load-indicating resistance) = 15.3 ohms
R_r (the load-indicating resistance in series with load indicating relay) will be taken at 0, 1.0, 4.0 and 7.65 ohms.

By assuming values of R_x as given above the following values of e are obtained:

Table I

Rx	e
0	5.4
1.0	23.0
4.0	75.8
7.65	139.3

Note—The figure 7.65 is the center point of the resistor.

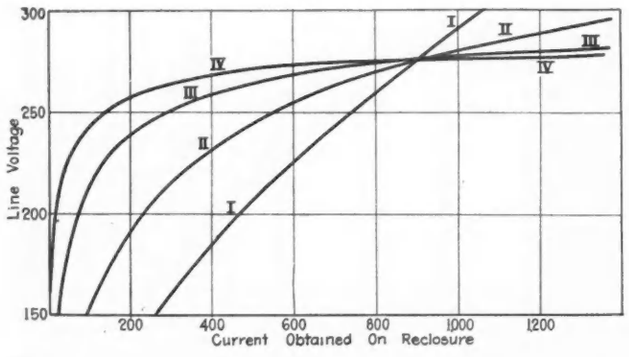


Fig. 5—Curves showing variations in current obtained on reclosure with variations in line voltage for various connections of the reclosing relay

With the value of the reclosing calibration, e, determined for a given set of conditions, the effect of variations in operating voltage on current obtained on reclosure may be determined. Variations in operating voltage are a frequent occurrence in mining service, because of the extensive use of overcompounded motor generators which have a no-load voltage of 250 and a full-load rating of 275 volts. If shunt machines are used the voltage will be less at full than at no load. The voltage of a substation bus may be affected by a feeder other than the one which is attempting to reclose, so it is not safe to assume that a feeder will always be called upon to reclose at the same value of bus voltage. Reclosing equipment is sometimes located at a point remote from a substation, so that its operating voltage is subjected to voltage fluctuations due to variations in feeder drop with load. An automatic reclosing feeder equipment should, therefore, be capable of operating satisfactorily over a wide voltage range.

To study the effect of voltage variations it is desirable to plot a set of curves to show the variations in load obtained on reclosure with variations in operating voltages. Using values of e from the accompanying table and rearranging equation (1) to give $R_L = \frac{eR_R - ER_x}{E - e}$ we may solve for values of R_L. Since the current obtained on reclosure is $\frac{E}{R}$, we may solve for the reclosure current. Plotting these values we obtain the curve shown in Fig. 5.

Curve I shows the values of current obtained on reclosure when the coil of the reclosing relay is connected directly across the load; that is, $R_x = 0$. It can be seen that through the operating range this curve is practically a straight line and that an excessive value of current cannot be obtained on reclosure even through the line voltage be increased considerably. Curves II, III, and IV show values for 1.4 and 7.65 ohms respectively for R_x. The more resistance there is in series with the relay, the wider is the variation in reclosure current with line voltage variation, and, when a value of 7.65 ohms (coil tapped to center of resistor) is reached, a slight increase above normal bus pressure will allow the reclosing equipment to close on a short circuit. Reclosure on a short circuit could be prevented by raising the setting of the reclosing relay, but this procedure is open to the objection that the equipment could not pick up a heavy load and could be held open by a few small motors or by the mine lamps. An examination of the curves will show why this is so. Raising the calibration point of the reclosing relay has the effect of shifting the curve up.

A further study shows that the "feeling out" characteristic of an automatic reclosing equipment for stub-end feed should be different than it is for multiple feed. The load to be obtained on reclosure under stub-end conditions depends upon the circuit voltage and upon the resistance of the feeder circuit and load, whereas the load obtained under multiple-feed conditions depends upon many factors, difficult to measure. Some of these factors are: (1) Amount and location of the load with respect to machines; (2) resistance of various circuits involved, and (3) load characteristic curves of machines.

It has been found that a measurement of the voltage difference between circuits that are being tied together is a reliable indication of the load to be obtained, and one type of reclosing equipment which is now on the market uses a relay, known as a voltage equalizing relay, connected as shown in Fig. 6, to determine reclosure under multiple-feed conditions. In addition, a second relay, known as a selective relay, determines whether the equipment should feel out the circuit under stub-end or multiple conditions. Thus, in all, three relays are used: a stub-end reclosing relay, a selective relay, and a multiple-feed (voltage equalizing) relay. This makes possible independent adjustment of the reclosure values under the two conditions of feed.

Other types of equipment which use the center tapped resistor plan of operation use the same relay for determining reclosure under both sets of conditions. It can be seen that this results in a compromise setting on the reclosing relay. To pick up a heavy load on stub-end feed, the relay should be set at 139.3 volts (from Table I). This would allow the circuits to be tied together with a voltage difference as high as 270 volts. It has been found that, under usual mining conditions, circuits may be tied together with voltage differences of from 25 to 125 volts, depending upon the load, feeder circuit resistances, and other factors. To allow reclosures with a voltage difference of 50 volts, the reclosing relay would be set at 250 volts (the machine voltage, 275 volts, minus one-half the drop through the load-indicating resistor, or 25 volts). Reference to the curves shows that this setting prevents reclosure on heavy load under stub-end feed conditions, and trouble may be experienced due to failure of the breaker to close because the mine lamps may provide sufficient load

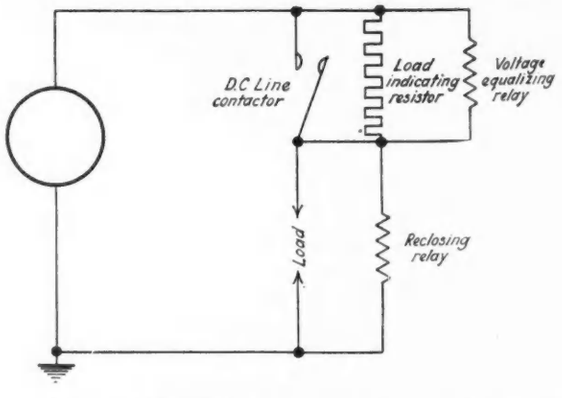


Fig. 6—Simplified diagram for combined stub-end and multiple automatic reclosing feeder equipment

to prevent reclosure. It seems obvious, therefore, that the compromise setting is not desirable.

As previously mentioned, the mechanical characteristics of the equipment should be such that it will assure reliable operation under mine conditions with a minimum expenditure for maintenance. For this reason the devices used should be of strong design. Most of the reclosing equipment being installed at the present time uses a contactor instead of a circuit breaker, because the contactor, having proved its worth in steel mills, is known to be a very rugged and reliable device.

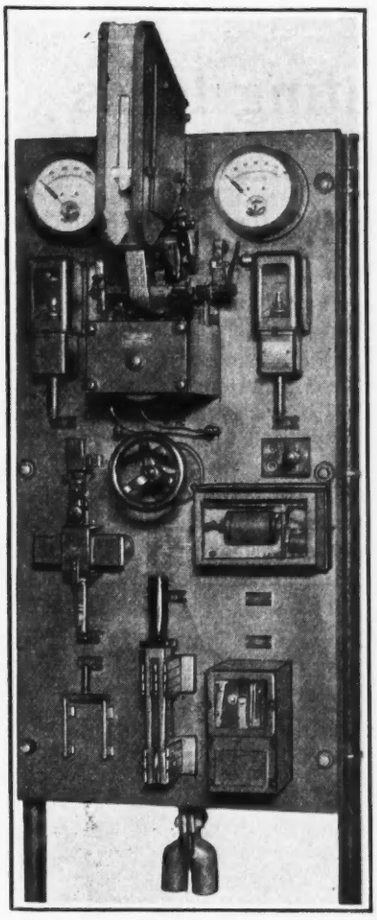


Fig. 7 — Automatic reclosing equipment for combined stub-end and multiple feeder

An automatic reclosing equipment for combined stub-end and multiple feed is shown in Fig. 7. The circuit-interrupting device is a contactor and the overload tripping feature is obtained by the use of a series-type overload relay. The reclosing values for stub-end and multiple feed may be independently set, and a selective-control relay provides for automatic determination of the method of reclosure which will govern. A bellows time-delay relay keeps the circuit open a definite time, irrespective of the cause of opening. An ammeter and a lever switch are furnished in accordince with the requirements of the service to which the equipment is to be applied.

In general, the installation of automatic reclosing equipments will make possible large increases in mine production and will reduce power costs, but, before purchasing such equipment, careful consideration should be given to its characteristics as well as its cost.

South African Fluorspar Remarkably Pure

Workable deposits of fluorspar have been found in the dolomite formation near Ottoshoop, Zeerust, South Africa, where the deposits being worked are roughly circular in shape, varying from 70 to 150 ft. across. The deepest workings are at present about 60 ft., the deposits consisting of a high-grade mineral, averaging approximately 99.5 per cent fluorspar, with a maximum of 0.3 per cent silica. An export trade has lately been initiated, which shows indications of a large increase, owing to the extraordinary purity of the ore, no preparation being necessary before the product is marketed.

A Method for Testing Radium Ores

By H. H. Taft

Several articles have appeared lately in *Mining Journal-Press* indicating some difficulty in the field testing of radium ores. There is an instrument that can be purchased, or even made at home, that costs only from $1 to $3 and is little larger than a Coddington lens. It is called a spinthariscope and is not much different from a scintilloscope. With this, a hundred or two hundred samples can be tested in an hour any evening. It is only qualitative, but like all qualitative tests one can get a fairly good conception of whether the ore is rich or poor.

The instrument depends upon the use of luminescent zinc sulphide. In the scintilloscope the zinc sulphide is mixed with a very little highly radio-active salt, and this is observed in the dark with a lens—an ordinary magnifying glass. This zinc sulphide can be purchased from any of the large chemical houses in pound lots. It is used to make luminescent paint. It is a fine yellow crystalline powder that will glow after being exposed to sunlight; consequently it must be kept in the dark. A grain of this substance is sufficient.

A small and cheap lens can be fitted in the end of a tube whose length is about a fiftieth of an inch more than the focal distance of the lens. In the other end of the tube fit a glass disk and spread on the outside of this disk some transparent gummy substance, as a drop of a solution of gum arabic. Sprinkle on this a very little of the zinc sulphide. Put this instrument away in the dark until the next night, when it should be ready for use.

The zinc sulphide is sensitive to light and must be kept dark. Wrap it in a black cloth and put it in a shaving-stick box or a small baking-powder can to keep out the light. A little moonlight has no effect, or a very little lamp-light for a few seconds to get started is admissible.

The zinc sulphide, when brought close to the radio-active ore, will spark, and this light can be seen through the lens if properly focused on the zinc sulphide through the glass disk upon which it is pasted. It is an interesting phenomenon, and it is a pleasure to watch the scintillations from a rich piece of ore.

Mineral Production in South Australia

The Director of Mines in South Australia (L. Keith Ward), in his last half-yearly review of the progress of the mining industry in that state, says that work has gone on satisfactorily. At Iron Knob, whence all the supplies of iron ore are obtained for the iron and steel works of the Broken Hill Proprietary Co. at Newcastle, New South Wales, there has been continuous productivity on the average scale, and the steady maintenance of the large daily output throughout the period is in itself a noteworthy achievement in mining and transportation.

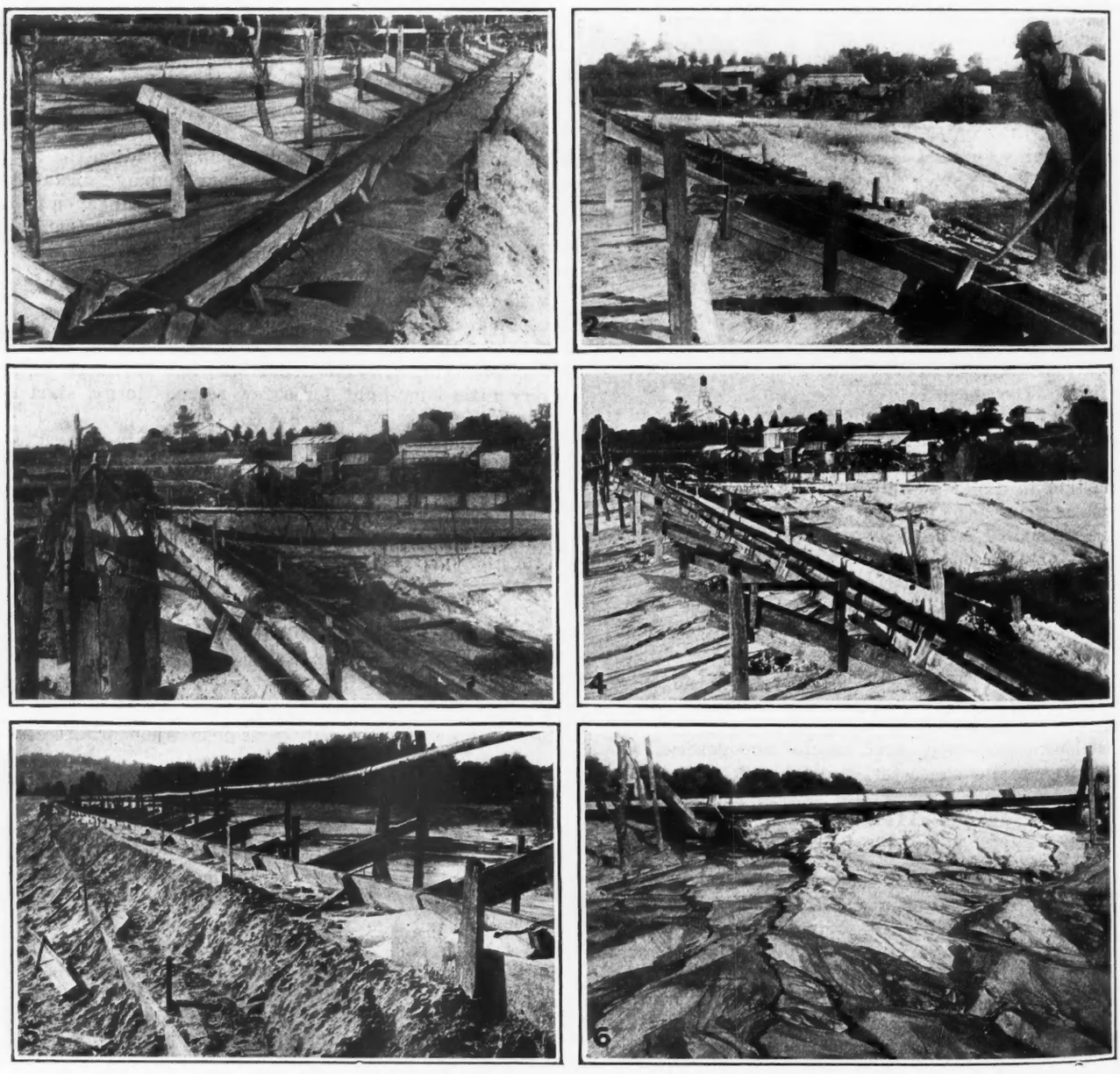
The gypsum deposits of the Hundred of Kevin, near Lake McDonnell, Mr. Ward says, are now producing regularly, and one plaster factory, fed with raw material from this immense source, is already in active operation. The regular export of raw gypsum from Cape Trevenard is also well established. The salt harvest has been satisfactory, and of the other non-metallic minerals barytes has been worked steadily in response to an assured market.

Useful Operating Ideas

Building Up Tailings Ponds

At the cyanide plant of Hamilton, Beauchamp & Woodworth near Jackson, Calif., an interesting method of building up and extending tailings ponds has been developed. The tailings are transferred by pumping from a pit to an iron tank which connects with a launder supported on frames at the desired grade as shown in Fig. 1. The launder is built of three pieces, a bottom board 1x8 in., one side board 1x8 in. and the other side board 1x3 in. A 1-in. hole is bored at intervals of 2 ft., the hole being so placed that when the launder is supported at an angle of 15 deg. on the frames, the hole will discharge directly downward. The front board is at such a height that, should the launder overflow, it will discharge away from the edge of the pile and toward the pond side. The supporting frames are 10 ft. apart. At a short distance in front of the discharge side, a line of 2x12-in. boards is placed, edge up, supported by stakes as shown in Fig. 1. This is made tight by banking the sand up on the slope.

Experience has shown that it is best to deposit both sand and slime together, the proportion of slime in the pulp best suited for constructing the bank being 30 per cent, although the bank can be built sometimes with a smaller proportion of slime. The holes in the launder



Figs. 1 to 6. Details of the method of building up tailings ponds employed at cyanide plant of Hamilton, Beauchamp & Woodworth, at Jackson, Calif. (See text)

are all left open and freely discharge as shown. As the bank builds up it successively cuts off the discharge holes, one by one, bringing the pulp stream finally to the end of the launder. When the bank has been built to the height determined by the launder's position, the operator slides the launder up on the sloping frames to a higher position as shown in Fig. 2. In Fig. 2, in the foreground, an auxiliary frame is shown which is used to establish the slope of the supporting frames. A level is placed upon the top of this frame and the inclined piece brought to position and nailed in place. When the operator has shifted the position of the launder, the toe boards are likewise shifted to a new position, close to the launder as shown in Fig. 3. In the illustration the operator has moved a plank up and set it in position against two stakes and is shoveling sand back of it. Sand is always taken from the pond side of the bank. The boards prevent any flow down the face of the dam and cause the pulp to run back into the pond. Fig. 4 shows a plank in place and the lower plank which is to be moved to its new position. Fig. 5 shows how the launder has built up the bank and plugged off the holes. Fig. 6 shows what happens when the pulp is too dilute. The stream erodes the sand and slime bank.

By systematic bank building in the manner indicated the whole pond is encircled by a new bank. The pulp is then allowed to fill up the pond. A new bank is built up and additional space secured.

By the use of transverse launders at intervals a wall can be built up 10 or 12 ft. in width at the top and 6 ft. in height. Pond space can also be built up on a side hill. The method can also be used in building a tailings dam by first constructing a thin concrete wall braced by buttresses at intervals and then building up sand banks on each side. These serve to complete the dam and if drainage openings are provided hydrostatic pressure is prevented from accumulating.

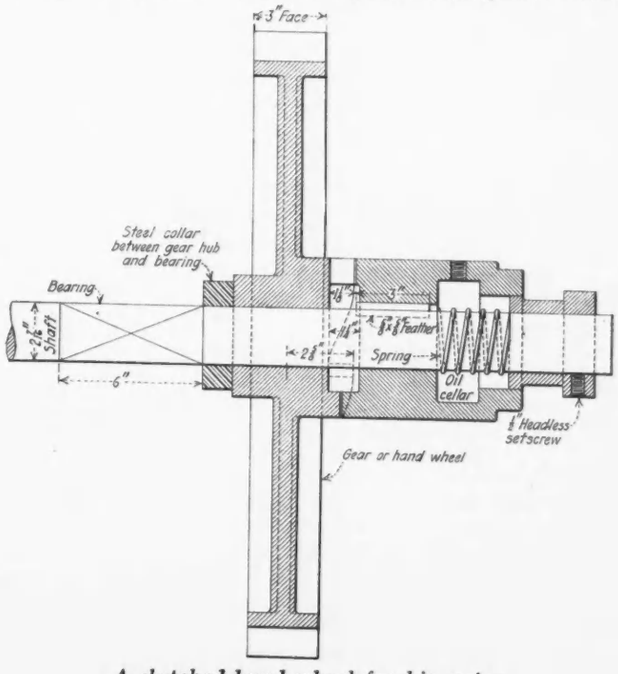
The labor required is nominal in amount. One man can take care of 10,000 tons per month, and it is estimated that this could be increased to 20,000 tons. The monthly tonnage handled depends upon the length of the dam. Experiments are now being tried out with pipe in place of launders for distributing the pulp. In Fig. 1 a pipe is shown in position, but its efficacy is yet to be determined. Acknowledgment is made of the courtesy of Hamilton, Beauchamp & Woodworth, who supplied the photographs used. The system described was devised by W. A. Darrow.

Novel Hand Wheel for Chute Gate

By W. J. Tait

Chute gates moved by a rack and pinion operated by gearing or hand wheels sometimes fall, and the wheels are broken by the sudden stoppage at the end of the gate travel. The hand wheel shown in the accompanying figure is designed to prevent such breakage. It is loose on the shaft carrying the pinions which engage the racks on the gate. A spiral jaw clutch on the hub of the wheel engages a corresponding clutch on a feather carried by the pinion shaft. The latter part of the clutch is held in engagement by a spring concentric with the shaft and adjustable to any desired compression by a collar held in position by a setscrew.

In opening the gate the hand wheel drives the pinion shaft through the clutch, which is right or left hand, as required. Should the gate fall, the hand wheel is driven in the reverse direction by the fixed part of the clutch. When the gate reaches the end of its travel the hand wheel may expend its momentum in a few more turns, the spiral jaws thrusting the fixed part of the clutch out of engagement against the spring. When the wheel stops the clutch engages and is ready for operation again.

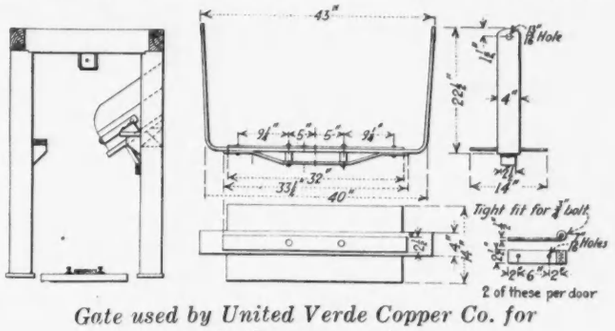


A clutched hand wheel for bin gates

Chute Gate Construction

A simple form of gate devised and in use at the United Verde mine, Jerome, Ariz., is here illustrated. The gate is of all-metal construction and is standard for gangway chutes. The stop plate is 32 in. long by 14 in. wide, of ⅜-in. steel plate. This is attached to a U-shaped piece, ½x4 in. in cross-section. The wings of the U-piece are 22½ in. long, and are bored with a 1⅛-in. hole near the end. A front piece, ⅜x2½ in. in section, is bent to form a truss. This is bolted to the U-piece with ⅝x3¾-in. machine bolts and 1¾-in. collars, as shown in the detail. It serves the purpose of a hand hold and stiffens the stop plate and U-piece.

Two additional pieces, of ½x2½-in. steel, are provided for hinges. One end is bent to a round to receive a ¾-in. bolt, which holds the end of the U-piece. A wooden bracket supports the hinge pieces, which are attached by four lagscrews, ⅝x3 in.



Gate used by United Verde Copper Co. for standard gangway chutes

Discussion

"Mining Engineering Education"

THE EDITOR:

Sir—Your editorial "Mining Engineering Education" in the *Mining Journal-Press* of Feb. 7 merits discussion of a topic that concerns all those who are interested in the future of the mining engineering profession. While the following may not be "*exactly* what is happening," five reasons are given why "*something* is happening" to the mining schools of the United states.

SUPPLY AND DEMAND

During the early 90's the trained technologist received his first widespread recognition as a valuable aid in mining. Demands came from South Africa, Mexico, South America, and the United States for American-trained mining engineers. Immediately colleges and universities set up courses or increased their teaching staffs to meet the demand of young men eager to enter this lucrative field. By 1905 the saturation point was reached and many of those who from 1900 on had fallen into the minor positions created by their more fortunate predecessors found themselves in "blind alleys" so far as advancement was concerned. True, many did not belong. The attraction of high salaries had its effect on too great a number who were not of the right type. These fell by the wayside. The force of their rancor is being felt in mining schools at the present time.

The group which was graduated from 1905 on met with the additional discouragement of declining salaries. They had to await their turn to secure the minor executive or technical positions that had been the stepping stones of those before them. They were advised to become muckers or what not until an opportunity came for advancement. Some of them got this opportunity, but many are not yet beyond the shift-boss stage. Their sons who are in high school or college are studying anything but "mining engineering."

CIVILIZATION VS. PIONEERING

While few experienced mining engineers would confess to anything romantic in their make-up, I wonder how many would be in the profession today if they had not heard the stories of the Comstock, the Coeur d'Alene, or the Days of Forty-nine? The evidences of sudden wealth, the first-hand stories of adventure and the men who had attained fame through mining were yet alive in the 90's and early years of 1900. The sons of these pioneers were among those who first went out of our mining schools to pioneer a new profession in this old industry. There was romance in this work as well as hardship. That romance has gone. Progress and standardization have changed all that. Commerce has produced its heroes since. The picturesque mining engineer of the past is gone. He is succeeded by a corps of specialists, a few of whom find romance in pursuit of the elusive atom or ion, but most of them are engaged in the deadly chase of the equally elusive dollar. In all of these hunting expeditions other industries offer parallels with equal thrills while living in more populous centers. If a man is just a good plugger without the urge of discovery or invention, why not plug in the city?

Although some of us with ingrown pioneering disposition stick to the desert by choice, the average man or woman prefers the verdure one sees in coast or valley towns. A few years ago, my son, then eight, said to my wife, "Mother, I'm not going to be a mining engineer when I grow up. I want to live where there are grass and trees." That appeal struck home, although it was some time before conditions permitted me to grant it. Other wives and children are no doubt producing their effect on mining school attendance today.

BUSINESS OR TECHNICAL

Now we come to the question suggested by your editorial.

Is a mining school graduate a business or technical man?

Is a mining engineer a technical or business man?

If *either*, which *should* he be?

If *both*, how *shall* he be?

As one casts his eye over the list of successful mining men he finds among the managers, presidents, and owners the names of business men as many if not more times than those of technicians. We all concede that mining properly conducted is a business. Then why not business men at its head?

Our mining schools have been turning out technical men for years. Have they an equal break with the college of commerce men to secure the "top jobs"?

It is true a few of our mining engineers have gained eminence and financial independence through technical inventions or discoveries; but how will their numbers compare with those whose influence in the mining world is a result of business training and logic?

COLLEGE CURRICULA

I am going to attempt to answer some of my own questions. I believe that mining engineers should dominate the mining industry. I believe that a mining engineer should be both a business man and technician, to succeed. I believe that he can be both. I think the reason that he has not been both is that the mining schools have failed to train him for it. They have served him an unbalanced diet. Our mining schools are top-heavy on technical subjects; not enough time is given to economics or sociological topics. They are missing that which Charles M. Schwab terms "human engineering." I have known college graduates who could tell you offhand the formula for starch, but who did not possess enough of it to issue an order to a Mexican mucker. I have seen men who could integrate a difficult problem in calculus, but were unable to figure a bill of materials for a bunk house. Manifestly, such

men should have been eliminated before graduation or should have been trained while in college.

It has been my observation that the men well grounded in the basic subjects of applied mathematics, chemistry, and physics, who knew the *why* of problems that arise in the field, are much more valuable assistants than those who can spin off yards of information about calculus, metallography, and those other higher subjects that crowd the curriculum during the upperclass days. Some of these subjects might well give place to basic training in business ethics, mine accounting, and foremanship, all of which the mining engineer must use. Extensive courses in economic geology, metallurgy, and the correlated subjects for these highly technical and special lines should be elective for those who choose the technician's career. Since the rapid decline in the attendance curve became apparent to our mining schools, attempts have been made to make up the deficiency in their curricula, but much has yet to be accomplished in the arrangement of subjects before the student can leave with the feeling that he has received a well-balanced ration.

Teaching Methods

There has been a great evolution in methods of instruction in our elementary and secondary schools during the last twenty years. Old-timers look askance upon what they term new frills in teaching, but intelligence and achievement tests demonstrate the fact that present-day students are as efficient and are better informed than were those of former years, even in the subjects most stressed then. Our colleges have not kept pace with this movement. If we except the schools of education (which are earnestly striving to train their teacher-graduates to teach), we find our colleges and universities clinging to the methods of twenty years ago, and expecting the undergraduates (who have had their work made interesting for them in high school) to sit through lectures that are hard to endure even from the best of speakers.

Too many of them are still employing instructors whose sole experience in life or their profession has been gained in the classroom. Can a person whose atmosphere has been made up of theory only, really teach a subject? I think not. There must be something besides the theory to motivate a boy's interest before he can absorb a great deal of any subject.

These are two points on which our technical schools are falling down badly: personnel and method. Engineering faculties are in need of some real training under "up-to-date" educators.

The large colleges are more at fault in this than the smaller ones, because of their size. Without a radical change in their programs or an increase in their faculties they are of necessity restricted to offering lectures to classes ranging in size from fifty to one thousand. A modern educator would not expect to get across instruction with such groups. The small college has held its attendance over the larger for two reasons, (1) more individual instruction and (2) more practical types of courses because of proximity to the mines.

It is not so much that the student has a natural interest in more practical things, but that he can see the practical application of the theory when he has it demonstrated on the ground at the time.

For a long time our technical colleges led in the practical methods of teaching through laboratory work, but they seem to have overlooked the fact that industry has now outstripped them in the field of research and its commercial relation to industrial problems. Until they realize this and can turn out men who are on a par with those who are being trained in the industry itself, they may expect their attendance to decrease.

Carson City, Nev. F. Dean Bradley,
State Director, Nevada State Board
for Vocational Education.

Engineer's License Bill in California

The Editor:

Sir—Your issue of Feb. 14 tells us that the San Francisco section of the A.I.M.E. has gone on record as against an engineer's license bill in California. Well, California already has one horrible example in a surveyor's license, and if it is any criterion the San Francisco section's action has ample justification. This law provides that any survey the plat of which is to be made a public record, a suburban subdivision for instance, must be made by a licensed surveyor. An acquaintance recently told me of his experience with this law, which would have been funny if it had not been so exasperating. This man has had experience in almost every conceivable kind of surveying, but has not, since coming to California, been engaged in the kind that required him to take out a license. Recently some work came up that seemed to make a license desirable, so he went to the State Surveyor General in Sacramento to find out what he had to do. Here he found the process to be a very simple one, no embarrassing questions about qualifications or experience, no bothersome examination to take; all he had to do was to submit an application on a certain form, endorsed by three *licensed surveyors*, and pay $10.

There was the rub. His work had been such that he hadn't been brought in touch with licensed surveyors, and if he did know any they were in a far-away part of the state, and he wanted that license in a hurry. He had an inspiration. He had a commission as United States Mineral Surveyor, fortified by a $5,000 bond, and granted him by the United States Surveyor General after he had spent three days on a stiff examination. Surely that would count for something; but the clerk to whom he appealed pointed out that there was no such provision in the law. Well, would the indorsement of the United States Surveyor General carry any weight? Not unless he was also a licensed surveyor of the State of California. The clerk then bethought himself of a provision of the law permitting the licensing of graduate civil engineers without the further indorsement. Our friend saw a light, but, alas! he was a graduate *mining* engineer and not within the scope of that provision. Finally the clerk provided him with a list of about 1,200 licensed surveyors and he took it away with him to see if he could pick three of them somewhere within reach to indorse him.

I don't know how he came out, but it is certain that so crude a law as that is no protection to the public or to the profession, and there seems to be no reason to assume that an engineer's license bill would be any better, at least not unless it were drawn with the assistance of engineers who appreciate the standards of the profession and what is necessary to maintain them. Leroy A. Palmer.

San Francisco, Calif.

News of the Week

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Summary

RECENTLY opened platinum deposits in the Lydenburg district of South Africa are characterized by Owen Letcher, of Johannesburg, as being, potentially, the "most prolific platinum producers" ever discovered.

Placer gold deposits in the Republic of Yakutsk, in Siberia, are attracting prospectors from points thousands of miles away.

Teck-Hughes Gold Mines, Ltd., plans to increase the capacity of its 100-ton mill at Kirkland Lake, to 250 tons.

The starting of several new concentrators in the Joplin-Miami zinc-lead district will increase output materially.

Considerable opposition is expressed to the tentative plan of the Department of Commerce to promote foreign trade in lead and zinc.

Mining in northeastern Washington is increasingly active with the coming of spring.

Numerous important exploration projects form an important part of the current activities in the Michigan copper district.

Encouraging developments are reported on the lower levels of the Magma mine, at Superior, Ariz.

There is a marked tendency on the part of London financial houses to seek base-metal properties in preference to gold and silver mines.

Active Spring Promised in Northeastern Washington Mines

Dominion Silver Lead Plans Mill—Metaline Mines Reopened—Increased Magnesite Output

The mines of northeastern Washington are showing renewed activity. In the last few weeks several development projects have been resumed after suspending operations last fall.

In Stevens County, the Dominion Silver Lead Mining Co. is developing high-grade silver-lead-zinc ore, which requires concentration before it can be marketed. Plans are now under way for the construction of a mill as soon as the metallurgical treatment has been fully determined. Farther north, the Gladstone mine is shipping high-grade crude lead ore, and has just disbursed a dividend of ½c. per share. A large tonnage of ore has been blocked out.

The Admiral mine, near Valley, will soon start shipping crude copper ore. The mine has over 5,000 ft. of underground workings, a large proportion of which are in ore.

In Pend Oreille County the Metaline camp, after laying dormant for many years, has come to life. Many almost forgotten prospects are being explored. The ores of the district are lead-zinc in lime formation.

The Diamond R and Bella May group are being operated, and high-grade lead ore is being shipped to the Bunker Hill smelter. On the Grandview property, a mile from the town of Metaline, a rich strike of high-grade lead ore has been opened by work now in progress. The Washington and Oriole properties have resumed operations, and the camp generally is coming out of its lethargy.

In Cheland and Okanogan counties interest in mining is increasing. The Holden group, on Railroad Creek, has been bonded to Eastern people. The property has excellent showings of high-grade copper silver ore, and extensive plans are outlined for development the coming season.

The old Mammoth mine, in Okanogan County, which has been shut down for twenty-five years owing to extensive litigation, which has finally been settled, has been taken over by W. E. Mintzer, of Pateros. The property in 1900 was producing $1,000 per day gross in silver-gold ore when litigation started among the stockholders.

At Chewelah, the Northwest Magnesite Co., which has been operating with one kiln, has started the second to take care of increased business.

Teck-Hughes Will Enlarge Mill to 250 Tons

IT IS STATED on good authority that the Teck-Hughes Gold Mines, of Kirkland Lake, Ontario, will enlarge the present mill to 250 tons a day, work to begin in the immediate future. The original program did not provide for any enlargement until after the shaft had been put down to a depth of 1,600 ft. and three new levels opened up. The capacity of the present mill is a little over 100 tons a day, and the increased mill should double the output of the mine.

The company is in first-class condition, with approximately $1,000,000 cash in the treasury.

Starting of Mills Will Increase Joplin-Miami Production

Several Hundred Tons Added to Weekly Output—Thirty-eight Now Run Night Shift

Production in the Joplin-Miami district will be increased somewhat by the recent starting up of three new properties and the reopening of several that have been down for some time because of temporary troubles.

The new mills are those of the New Chicago No. 2, the Wade, and the Century Zinc Co.'s Malsbury mill, south of Baxter Springs, Kan. Those that are resuming operations after being down for some time are the Crestline Products Co., in the Crestline, Kan., camp; the Blue Ribbon and Freehold No. 4, in the Waco, Mo., camp; and the Midas and Skelton No. 7, in the Picher camp. These properties will increase the production several hundred tons a week, though their output will be offset to some extent by the temporary closing down of the Cunningham, near Commerce, and the Leonora, south of Picher. Two more companies also have adopted night shifts recently, making thirty-eight now using night forces.

There is still room in this direction for further expansion of total production for the district.

The starting of the Crestline mill, at Crestline, was made possible by resumption of pumping by the Eagle-Picher Lead Co. in that field. When this company's Ellis mill was burned, several weeks ago, other properties in the section were forced to close down, owing to heavy water consequent to shutting down the Ellis pumps.

Oliver Iron Mining Co. Starts New Crushing Plant

Erecting the new crushing and screening plant of the Oliver Iron Mining Co. at Hibbing is moving forward rapidly. The American Bridge Co. has a crew of sixty men erecting the steel. More than two thousand tons of fabricated steel is on the ground, with 1,200 tons still to come. All foundations are now done, and the mine crew is erecting a wood trestle, that the approach may be filled to its maximum height. Piles are being driven to support the main railroad line across a small muskeg swamp. A fill will be laid on top of the piling. This plant will be the same size as was erected at Virginia last year.

Utah-Apex Heavy Producer

The Utah-Apex mine, at Bingham, Utah, is now employing 700 men, in comparison to 300 six months ago. A large tonnage, equally divided between ore of shipping grade and mill ore, is being mined. Net earnings for February were $155,000, and in January, $185,212, which, with March estimated at $175,000, would make $515,212 for the first quarter of the year. The cash balance amounts to $1,400,000.

Clark Interests Examine Big Seven Property at Neihart

Reports from Neihart, Mont., state that engineers representing the Clark interests, of Butte, are making an extensive examination of the Big Seven property, which is controlled by the Big Seven Group, Inc. This mine was first operated in 1892, and has been a rather intermittent shipper ever since. Much development work has been done. The deepest level is 1,800 ft. A fair tonnage of ore is said to be blocked out.

Industrial Mexicana Will Reopen Cuatro Amigos Property

The Cia. Industrial Mexicana has moved its assay office from Saltillo, Coah., Mexico, to Lulu, Zac., where work has been started on the Cuatro Amigos property. This is an old mine which was declared "caduca" several months ago, owing to the taxes not having been paid, and was denounced by this company. The work for the present will consist of developing the vein to the south of the old mine, in a small surface working where there is a showing of good lead-silver ore with a streak of good zinc ore on the footwall and cleaning out broken waste from the old workings and mining lead-silver and zinc ores.

J. R. Luevano, owner of La Goleta mine, near El Salvador, Zac., reports work progressing well. He now has seven faces in good copper ore.

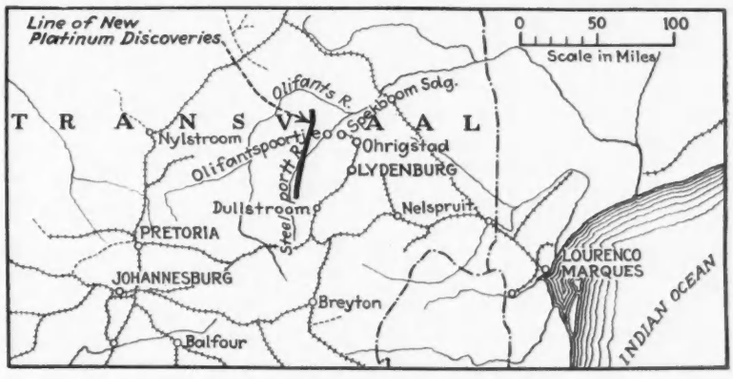
General Eulalio Gutierrez has purchased machinery for a 50-ton concentrating plant and will erect it at Concepcion del Oro, Zac., to treat the low-grade ores from his mines in that vicinity.

World's "Most Prolific Platinum Producers" in South Africa

Engineer Makes Forecast After Visit to New Lydenburg Fields, North of Johannesburg

By Owen Letcher
Editor, *South African Mining and Engineering Journal*

CONSIDERABLE scepticism has been expressed concerning the platinum discoveries in the Lydenburg district, in the Transvaal, about 150 miles north of Johannesburg. However, after a week spent on the new area, in the course of which I traveled along the belt for over 50 miles, inspected scores of trenches and shafts, took a considerable number of samples, and made and saw made many pannings, I have come to the conclusion that the platinjferous orebodies recently discovered in the Bushveld or western area of the district constitute a mineral discovery of the foremost importance; and that the deposits so far opened up will in all probability soon become the most prolific producers of platinum in the world.



Map showing the location of the Lydenburg platinum field, in the Transvaal

I am induced to express this opinion by reason of the remarkable persistency of the platinum-carrying orebody and by the values which I have ascertained for myself or that have been stated to me by persons whose opinions I respect and whose statements I believe to be true.

In the middle of last year prospectors operating in the Lydenburg district found that platinum was associated with certain types of rocks in an extensive norite belt generally containing certain quantities of chrome iron. Extension of prospecting activities has led to the location of payable quantities of platinum along two or more stratigraphical horizons over an area nearly 100 miles in length along the strike of the orebodies from north to south.

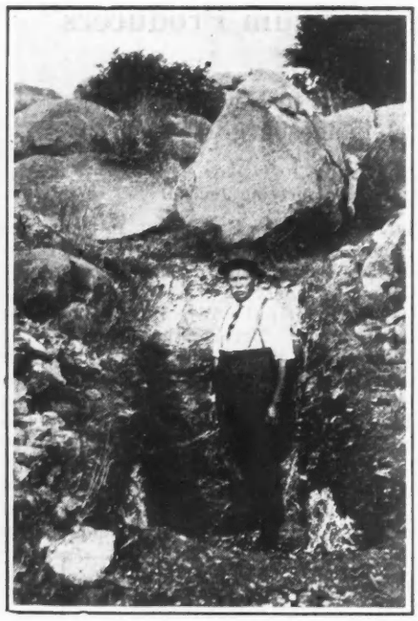
Sufficient work has been done (since September, 1924), to demonstrate the existence of a platinum belt extending from the vinicity of the town of Dullstroom, on the Belfast-Lydenburg railway, to the Olifants River.

The country is of a mountainous character, the general feature being high ridges with intervening valleys. The principal range of hills on the west is known as the Lulu Mountains. A plentiful supply of water is available from the Steelpoort and Dwars rivers, but north of the Steelpoort, in the direciton of the Olifants River, water becomes increasingly scarce, except at Maandagshoek.

The principal town in this area is Lydenburg. Before the discovery of platinum in this region the railway line had been extended north and west to the Steelpoort River, but no townships have as yet been established along the extension of the line, and Lydenburg, which is situated at a distance of about 50 miles from the central section of the mineralized belt, is the base from which visitors to the new fields begin their journeyings and from which supplies are drawn.

Lydenburg is the second oldest town in the Transvaal, but since the gold rushes of the 70's it has led a sleepy existence. The platinum discoveries recently made in the low-lying "Bushveld" areas have regalvanized the town into activity. What with company and syndicate promotors from Johannesburg flitting mysteriously in and out of the place, prospecting parties setting forth on expeditions of discovery and Dutch farmers possessing options to be bartered for, and their pockets bulging with pieces of "plateena"—as they term the new-found and fashionable ore—Lydenburg has become a thoroughly active dorp, and hotel proprietors, garage owners, storekeepers, and lawyers are each and all reaping a rich harvest. The difficulties of operating in the country are, however, very considerable. There are no roads to speak of, and if you elect to travel by automobile you will have to select a car capable of performing most of the functions of a "tank." The nearest mines department office is at Pilgrims' Rest, nearly 100 miles from the heart of the platiniferous area. Moreover, malarial fever prevails over a considerable portion of the area except in the winter months.

Despite all these obstacles, however, nearly every yard of ground along the line of strike of the orebodies and on their dip for a considerable distance has been acquired under option, and



An exposure of ore on the "Norite" belt

there are several farms which were owned prior to the discovery of platinum by large land owning companies, such as the Transvaal Consolidated Lands, the Transvaal Estates & Development Co., and the South African Townships Co., which are now being exploited. These concerns, and the Lydenburg Platinum Co. and the Platinum Proprietary Co., are the principal companies operating in the district, but in addition to these there are a large number of syndicates which have been formed in Johannesburg and elsewhere and which are carrying on work at various points along the line.

Story of the Find

The history of the discoveries in the Lydenburg district is briefly as follows:

In June last A. Lombaard, a farmer, found small grains of gold and platinum in the bed of a spruit on the farm Maandagshoek. The concentrates were submitted to Dr. Hans Merensky's office for examination. After a cursory inspection of the locality where these finds were made, Merensky advised the following up of the indications, the Lydenburg Platinum Syndicate, Ltd., providing the necessary funds for this work. On Aug. 12 his field work commenced, and within the first three days of their search, Merensky and his assistants succeeding in determining platinum in pyroxenite and associated ultra-basic rocks on the proclaimed government farm Mooihoek and on Maandagshoek. These rocks appeared on little kopjes. The best values were found on a kopje on Mooihoek, showing 4.2 and 5 dwt. of platinoids.

After having investigated a few small alluvial deposits along the spruits, it was proved on Aug. 25 last that the extensive alluvial flats on the Steelpoort River at Fort Burger also carried platinum.

A third and by far the most important discovery was, however, made in the first half of September, consisting of a band of grayish-green norite varying in thickness up to 40 ft. and carrying in its upper portion some gold, and, above all, platinum. The first assay values ranged from 2 to 4 dwt. of platinoids. This orebody proved so persistent that it could be followed within a few days through several farms north of Maandagshoek. In the first days of October the continuity of the same orebody was established to the south of the Steelpoort River. About the same time a prospector of the Transvaal Consolidated Land & Exploration Co. discovered platinum on the farm Onverwacht, belonging to that company, and platinum was also found considerably to the north and south of this area in the vicinity of the Olifants and Dwars Rivers respectively.

The Veil Lifted

At first, any reliable news regarding the new field was very hard to obtain. Many rumors were current, but extraordinary measures were adopted by some of the larger interests to cover up the tracks of their prospecting activities until they had acquired all the options they desired.

In December, however, a government proclamation which threw open three farms in the northern area of the fields for prospecting served to direct public attention to the precise locality of the platiniferous area.

There was a considerable rush on the part of agents working for the big land companies and individual prospectors to the area and since then the various interests have been consolidating their positions, and the veil of secrecy which enveloped the earlier operations has been largely lifted.

When the platiniferous deposits in the Waterberg region 100 miles to the west of the new Lydenburg line of country were discovered in 1923 the sceptics were in the majority. Alleged finds of platinum in other parts of South Africa had given rise to so much disappointment that one was predisposed to extreme caution in respect of the value of the discoveries made by the Transvaal Platinum Syndicate and its satellites in the Naboomspruit district of the Waterberg to the north of Pretoria. There had, too, been so many recent platinum "scares" in the United States and in other parts of the world that it took a long time to convince the public that the Waterberg finds were anything more important than a Johannesburg Stock Exchange flutter. The same applied to the Lydenburg district at the start.

The Waterberg and Lydenburg deposits are utterly dissimilar: In the Waterberg platinum is found in quartz lode of Post-Karroo age. In the newly discovered platinum fields it occurs as a primary constituent of ultra-basic and basic rocks belonging to the norite zone of the Bushveld igneous complex, and in eluvial and eluvial deposits derived from the disintegration of these rocks, the conditions in which it is found being very similar to those in the Ural Mountains and Colombia. The distribution of the platinum in the two types of deposits is also totally different. Whereas the workable sections of the Waterberg lodes have been proved to be rich and at the same time patchy,

Prospect shaft in the "Dunite" platinum area

the platinum contents of the Lydenburg district deposits are much lower, but, on the other hand, also much more consistent.

For the greater part of its length, the platinum belt has a north and south trend, but at its northern end it swings to the northwest in conformity with the strike of the rocks of the norite zone. It is bisected by the Steelpoort River, which divides it into a northern and southern section.

The Platinum Belt Described

Data available to date indicate that the upper body, which for the sake of convenience may be termed the pyroxene-norite reef, contains a greater consistency of platiniferous values over a much longer and more regular line of strike than does the lower or dunite horizon.

The upper or western platiniferous beds have seldom given pannings or assays in excess of 5 dwt. to the ton; but the values and width of the precious-metal carrier are remarkably persistent for at least 60 miles—so much so that this almost unswerving line of metalifferous country has been likened to the Witwatersrand and seems from several points of view already to justify the appellation of a "Platinum Rand."

The dunite, with its more eratic values and its apparently less persistent and regular characteristics, may be aptly compared with the Barberton, Pilgrims' Rest, Rhodesian, and other gold fields which do not possess those properties of consistency and persistency which characterize in such a remarkable degree the Witwatersrand. But this must not, of course, be assumed to imply that in numerous localities the dunite and its associated detrital matter will not yield handsome profits. Indeed, at two or three points along the line of exploitation, notably on the farms Onverwacht and Mooihoek, extensive sampling has already clearly demonstrated the presence of limited but highly profitable tonnages of platinum-bearing dunite. This is particularly so in the case of the dunite knoll, on Onverwacht, of the Transvaal Consolidated Lands Co. A vertical shaft sunk on the Dunite Hillock on this property had at the date of my visit penetrated to a depth of 32 ft. without

exposing the limits of the orebody. It is as yet impossible to place any dimensions on this remarkable deposit, or to say whether it is a lens or a pipe, or what term may best be applied to it as indicating the type of ore deposit to which it belongs. Its continuity over any very considerable line of strike has not been determined, but 140 tons of rich ore have already been extracted from this shaft and stacked, and it is probable that this ore will yield not less than 1 oz. of platinum per ton.

To the west of the knoll a large number of shallow pits have been put down to test the detrital matter weathered from the dunite, and pannings from these deposits have given remarkably high results. Though the dunite may be the most spectacular of the two horizons from the point of view of assays, it is in the overlying norite-pyroxene zone that the greatest hope is reposed for the establishment of an enduring platinum industry.

Will Values Continue in Depth?

There has been one great doubt in the minds of geologists and engineers who have inspected this horizon, and it is the fear that values would not continue in depth. Dr. Wagner, of the Government Geological Survey, refers to this consideration in his admirable article appearing in the February issue of the *Journal of Industries*, wherein he says: "Far more impressive than the lower horizon, by reason of the great distances over which it has been traced, is the upper or main horizon. The pyroxene-rich mottled sulphuric norite occurring on the horizon, as already pointed out, outcrops continuously for thousands of yards and carries from a fraction of a pennyweight to 7.5 dwt. of platinum over widths ranging from 2 to 8 ft. Values over considerable stretches have been proved to be fairly consistent, averaging from 2 to 3 dwt.

"Even more important, however, is the question of the extent to which the platinum content of the outcrop rock has been affected by secondary enrichment. Heavy metals, like gold and platinum, are extraordinarily susceptible to surface concentrations, and the outcrops of deposits containing these metals have sometimes been enriched in the most unaccountable manner.

"The fact that the platiniferous norite carries much the same values, whether exposed on the crest or slopes of the ridges, or in stream beds where there has been active denudation, or in isolated boulders lying on the surface, appears to indicate that there has been no marked enrichment, and the low dip of the sheet also seems to preclude this. The only way to settle the question, however, will be to sink a number of shafts to a depth, say, of 20 ft.—that is, below the possible influence of mechanical surface enrichment, and to sample the rock systematically at this depth. Until this is done, it will not be possible to express a definite opinion on the value of the main horizon as a potential source of platinum.

"It is quite possible that there will be changes in the platinum content of the norite at water level, which will probably be found to lie at an average depth of 70 ft. below the surface. With a dip of 11 deg., this would mean a distance measured along the incline, of over 360 ft. before it is reached. What happens below water-level is thus at present of little moment.

A Hopeful Outlook

"If, as it is hoped, values approximately equal to those found at the surface over certain of the stretches so far tested extend only to water level, and if but a small part of the great length over which the sheet has been traced should prove rich enough to work, there would still be enough low-grade ore available on this horizon to make this part of the Lydenburg district a platinum-producing area of first importance. Even taking the least favorable view, however, and assuming that there has been marked surface enrichment, and that the values do not go down, certain of the stretches sampled should yield a fairly big tonnage of workable surface ore."

It will be considerable time before any shafts on this horizon have penetrated to below water level, and until these have been sunk the question of secondary enrichment may be left in abeyance. I am, however, in a position to state that the work done at numerous widely separated points along the line of exploitation during the last month has fully confirmed the opinion that there has been little if any purely superficial and surface enrichment resulting from purely mechanical concentration at outcrop. Until more work—much more work—has been done, it would be futile to indulge in speculations as to the behavior and metal content of this remarkable orebody at any considerable depth, and on account of the very flat angle of dip of the orebody, there must in any case be an enormous tonnage along such a length of strike above water level.

Here, then, it would appear we have to deal with what is in all probability easily the most important platiniferous occurrence discovered anywhere in the history of the world. The opening up of these deposits should be undertaken at very reasonable mining costs, inasmuch as there is comparatively little overburden and in some areas, notably on Dwars River, for example, huge tonnages can be worked by adits. The norite, too, is easily broken. A further important consideration is that the ore would appear to be amendable to crushing followed by concentration on corduroy, with, perhaps, Wilfley or similar tables to recover the fine concentrates. The platiniferous ore would not therefore appear to present any difficulties to simple or inexpensive treatment, and the fineness of the metal has been determined by the staff of the Rand Mines, Ltd., to be 98.3 per cent.

Gold Showing Near Dixie, Idaho

The Mammoth Mines Corporation, with a capital of $500,000, has been organized at Lewiston, Idaho, to work mining claims in the Dixie district of central Idaho. Work on the property has disclosed a vein of gold ore on the surface, 20 ft. wide and assaying as much as $5.50 per ton. A drift for 2,000 ft. along the vein is planned.

Churn drill, mounted on a tractor and run by gasoline, at Chino

Gasoline Tractor Churn Drills at Chino

Two new tractor churn drills have been delivered at the Chino Mines of Santa Rita, N. M., to supplement the equipment of the Ray Consolidated Copper Co. The machines are gasoline driven, both for traveling and operating, and will be used for drilling blast holes before the power shovels in the mining pits. Although the blast holes are comparatively shallow, varying from 30 to 100 ft. deep, these machines are capable of drilling to a depth of more than 1,000 ft. Sixteen machines of this type are now in steady operation at the mines in Santa Rita. They are manufactured by the Sanderson Cyclone Drill Co. and are equipped with 18-hp. Cook Motor Co. gasoline engines.

Washouts Reported on Cerro de Pasco Railroad

Reports are in circulation that the railroad running from the smelters of the Cerro de Pasco Copper Co. in Chile to the coast has been shut down by a washout. Officials of the company confirm the statement of a washout on the railroad but say that operations have not been interrupted. If the washouts are or become serious it would seem probable that continued normal production would be impossible.

Will Open Lake Group at Idaho Springs, Colo.

The L. M. S. Mining Co. is a new enterprise, representing St. Louis and Denver capital, which has recently taken over the Lake group near Idaho Springs, Colo.

The property, which has been idle for more than a decade, will be operated through the Big Five tunnel, and the mines are now being cleaned out and retimbered preparatory to a large production. A pilot mill will be installed, after which arrangements will be made for a plant of larger capacity. Robert H. Sayre, of Denver, is in charge of operations.

The "Russian Klondike" Attracts Siberians

Rich Gold Strike in Yakutsk, on Aldan River—Remoteness Handicap —900 Km. From Railroad

By Alexis Goldenweiser

SIBERIA'S settlements are much excited. One hears about veritable "mountains of gold" discovered in the distant Republic of Yakutsk, on the River Aldan. A certain amount of official confirmation has encouraged the people to look for easy riches. Parties with full equipment are going to the mountains of the Aldan. Many send goods on sleighs. Any price is paid—100 rubles for 40 lb. is not excessive. The peasant drivers expect after reaching the Aldan to sell their horses and wagons and sleighs and to engage in gold digging. This lead is 2,000 km. from Yakutsk and 900 km. from the nearest railroad stations.

Gold has been discovered in the Aldan region as long ago as 1895, but until recently its exploitation has given no considerable results. Until 1910 the total output was only about 8,000 kg., and then production was discontinued; in 1917 a new survey was made, and in 1919 and 1920 small groups of gold seekers were at work, but it was not until 1923 that the big discovery was made, which immediately attracted several thousand workers.

The new gold region includes the following rivers: The Big and the Little Nimger, with their tributaries; the Seligdar, with its tributaries; and a large number of smaller streams entering the Aldan between the other rivers mentioned. At present the following places are worked:

(1) The Nesametny spring, which flows into the Ortosola. The region worked is about 1,300 m. long and 600 m. wide. The thickness of the soil above the ore is 1 m.; the thickness of the ore is 3.1 m. A gold content 77 gm. per cubic meter is usual, but there are pockets where the content is 430 gm.

(2) The Proletarsky spring, which flows into the Ortosola from the right. Its length is 1 km., its breadth, 30 m. and the soil thickness is 1½ m., and the ore thickness ½ m. The gold content is 30 gm. per cubic meter.

(3) The Orochen spring, with a length of 1½ km., a width of 30 m., a soil thickness of ½ m., an ore thickness of 1 m., and a gold content of 43 gm. per cubic meter.

(4) The Lebedinny spring, which flows from the left into the River Kuronos, a tributary of the Seligdar. The district worked is 2 km. long and from 6 to 20 m. wide. The thickness of the soil is 1.1 to 1.4 m., and of the ore 1.4 m. The gold content is 54 gm. per cubic meter.

(5) The enormous River Tommott, which is 70 km. long and 60 m. wide, with an ore bed 3½ m. thick and a gold content varying from 5.4 to 32.3 gm. per cubic meter. On the basis of these data, and for the sake of conservatism, taking only one-half of the gold content of the Tommott and the Nesametny, the estimated gold content of the region is about 238,850 kg.

In 1923 the Republic of Yakutsk concluded an agreement with the Union of Gold Prospectors by which the latter agreed to let the republic have 20 per cent of the gold produced, but the government receives only a small proportion of the amount due. For the period between May and September the total amount of gold that was actually registered was only 70 poods, (1 pood is 36 lb.), while production was in excess of 300 poods.

This gold-producing region is largely cut off from the rest of the world. From the next railroad station on the Amur Railroad there is a very poor wagon road 280 km. long to the Lebedinny spring. From there to the Tommott region there are only trails about 300 km. long, and then to the Nesametny spring there is another of 100 km. Beyond the Lebedinny, travel is possible only with reindeer. Two winter roads are being constructed from the station Pukhlov, one of 250 km. and one of 900.

It is very difficult to supply materials and food to the gold-producing territory. Everything in the region is figured on the basis of gold. For instance, a pood of wheat floor costs between 21 and 25 gm.; a pood of rye flour, 12 to 17 gm.

The discovery has received a great deal of attention in the Russian press, and the region is generally known as the "Russian Klondike."

Financial Writers and Brokers Visit Kay Mine

The Kay Copper Corporation's mine at Canon, Ariz. has been visited by the financial editors of most of the Los Angeles newspapers and several prominent eastern brokers and financial writers. About fifty men are now employed at the mine. Most of the work is being done on the 1,200, where about 2,000 ft. of drifting has been accomplished since the present company started operations by sinking the shaft from the 760 level to the 1,200.

Besides the drifting, a three-compartment raise is being driven from the lower level to the old Kay workings above, and diamond drilling is being done on surface and downward from the 1,200 level. Showings of ore on the new level, according to current reports, consist of a section 40 ft. long and 6 ft. wide, of chalcopyrite ore averaging 6 per cent copper and $2.50 in gold and silver. Work is progressing on the downward projection of the original Kay orebody. This lies in a vein about 80 ft. wide. The first 25 ft. of this vein from the footwall side averaged from 1½ to 3 per cent copper and $2.50 in gold and silver; 15 ft. next the hanging wall averaged 2½ per cent copper and $2.50 in gold and silver.

Plans are being made for the sinking of a new shaft, to be located 1,000 ft. south of the present main shaft, to a depth of 2,000 ft. It will contain four compartemnts and will cost $350,000 equipped.

Excellent Developments Reported in Magma Copper Mine

Recent underground developments at the mines of the Magma Copper Co., at Superior, Ariz., have been gratifying. On the 2,250 level No. 11 crosscut encountered 38 ft. of ore averaging 8¼ per cent copper. On the No. 13 crosscut miners are 50 ft. in the vein with the exact width not yet determined. The vein is well mineralized, and it is believed will run as high in copper as the No. 11 crosscut. The fact that these rich orebodies have been encountered at the deeper levels with the ores running just as high as in the upper levels is regarded as significant.

Another development that is expected to add to the value of the property is the discovery of a zinc orebody on the 1,500 level, about 1,500 ft. from the main shaft. Ore containing 15 per cent zinc as well as copper, lead, and silver has been opened for 300 ft. Though the extent of this deposit cannot be determined, indications are good.

Since the first of the year Magma's direct costs, it is said, have been averaging 6½c. a pound. Including depreciation and interest, the cost is around 7½c.

Galena, Kansas, Raises $100,000 to Help Mining

Almost $100,000 has been subscribed to a fund to change the course of Short Creek, at Galena, Kan., in such a way that mining may be resumed in this veteran camp without the operators being menaced with flooding from surface water as a result of overflow of the creek's banks.

It is believed the completion of work, which is to be begun in the near future, will bring about a sharp revival of mining operations in Galena. Careful estimates as to the cost of the project have been made, and it is believed the total expense will not be more than $75,000, but an effort is to be made to get $150,000 subscribed so there will be no danger of running short of money once the work is begun. Galena citizens are the principal subscribers.

Syndicate Will Spend $135,000 To Develop Selkirk Property

A Seattle syndicate has taken an option on 51 per cent of the stock of the Selkirk Gold Mines, which owns a consolidation of mining claims in the Sheep Creek district of British Columbia and includes the Motherlode and Nugget mines. The terms have not been announced, and the deal has to be ratified at a special general meeting of the Selkirk company, but it is understood that the syndicate is putting up $135,000 for the further development of the properties.

There is a modern mill and cyanide plant on the Motherlode property. Three years ago a tunnel was driven from the bottom level of the Motherlode to develop the Nugget vein at depth. The vein was 10 to 12 ft. wide, and levels were driven in each direction and stopes opened, but after a short period of operation the property was closed, and it has remained closed for about three years.

Columbia Steel Co. Earned $295,106 in 1924

Iron and Coal Mines in Utah Basis of Pig Iron Production—Costs Down

The Columbia Steel Corporation, in its 1924 report—which shows net profits of $295,106 for the year, after deducting bond and other interest to the amount of $523,924 and federal income taxes of $44,441—gives an account of its Utah operations, both at the plant at Ironton, where in April and May, respectively, it started operating coke ovens and blast furnace, and at its coal and iron mines in the southern part of the state.

The newly started iron industry of Utah is giving excellent results. At the end of the year the furnace practice approached close to the standard, and costs had come down to a very satisfactory level. Production is at the rate of 320 tons of pig iron daily. The coal and iron are coming from the company's Utah properties. Excellent coke is being produced from the coal, and the iron is of superior quality.

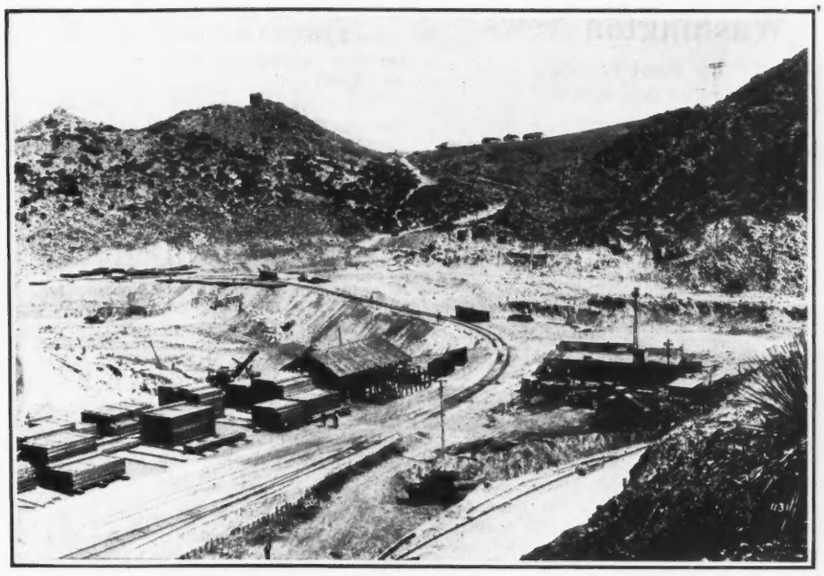
During the year, the bonded debt was increased $1,000,000. Current liabilities are $1,300,000, and additional preferred stock to the amount of $525,000 has been issued. This money was used chiefly in the development of Utah properties, where over $2,600,000 was expended in 1924, while additions to plants at Pittsburg and Torrance, Calif., were made at a cost of $35,000 and $125,000, respectively.

Quinton Zinc Smelter, Burned, to Be Rebuilt

Fire of undetermined origin wrought damage of approximately $100,000 to the zinc smelter of the Quinton Spelter Co., at Quinton, Okla., on March 21. About two-thirds of the property was ruined, though the offices were saved. More than 175 men were temporarily thrown out of employment. Jesse G. Starr, of Joplin, a vice-president of the American Zinc Institute, is president of the Quinton Spelter Co., and principal owner. The plant is to be reconstructed at once, according to officials of the company.

California Corporation Department Upheld in Court

The McCalla Co., during the oil boom in California, two years ago, offered "certificates" to the public through which the purchasers of alleged land were to receive a part of the profits from the land purchased under the certificate plan. Action was started against the company by the California State Corporation Department, and a conviction was obtained. Successive appeals were taken, the Supreme Court of California upholding the validity of the Corporation Securities Act. The case was taken to the U. S. Supreme Court, which dismissed it for lack of jurisdiction. This decision places the certificate plan of promotion in the same class as stock promotion as far as California is concerned.



Excavating for the Inspiration leaching plant

At Miami, Ariz., the Inspiration Consolidated Copper Co. is building a $6,000,000 leaching plant for the treatment of its mixed oxidized and sulphide ores.

Afterthought Flotation Plant To Be Moved to Bully Hill

The Bully Hill smelter at Winthrop, Calif., will, it is reported, shut down for sixty days owing to the fact that recent shipments of zinc oxide have satisfied Eastern requirements. In the interim the flotation plant at the Afterthought mine is to be removed to Winthrop, where it will be used for concentrating certain ores. Mining operations will continue at the Rising Star during the smelter shutdown. It is expected that when smelting operations are resumed, the Afterthought mine will supply 200 tons and the Rising Star 100 tons of ore per day.

Boston People Buy Kingston, Ont., Lead Property

The lead mine on the Perth Road near Kingston, Ont., owned by the North American Smelting Co., which has been idle for some years, has been purchased by a Boston Syndicate, which is preparing to install modern machinery and equipment. A force of men are engaged in preliminary work. The property carries an 18-ft. vein of ore of low grade. It is stated that the purchasers will expend at least $600,000 on the property during the next two or three years.

Metals Exploration Drops Brunswick Option at Grass Valley

The Metals Exploration Co. has relinquished its option on the Brunswick mine, at Grass Valley, Calif., and the owners of the property are now engaged in further development with the hope of mining enough ore to keep the twenty-stamp mill in operation.

E. A. Stent has taken an option on the Newton or Dull mine and has let a contract for drifting as a preliminary to shaft sinking to a new level.

Tonopah Extension Increased Earnings in February

The Tonopah Extension Mining Co. realized net earnings for the month of February amounting to $66,000. This is about double the earnings for January. Bullion shipments for the first half of March totaled 110,325 oz., valued at $91,570. A serious cave occurred in one of the big stopes on the Murray vein between the 1,040 and the 2,000 levels. A considerable tonnage was being mined from this stope, and it will be necessary to operate the mill at about half capacity until adjustments are made underground to bring the daily ore production up to normal. The normal capacity of the mill is 550 tons.

The Tonopah Belmont Development Co. reports 2,725 tons produced during February, with a gross value of $49,562. The West End Consolidated Mining Co. gross production for February was about $45,000. Bullion shipments for the first half of March were valued at $22,358.

New Orebody in Mammoth Mine at Eureka, Utah

An important strike made at the Mammoth mine, at Eureka, Utah, promises to bring back this old-time producer to its earlier importance. The find is in hitherto unprospected ground in that part of the mine nearest the Plutus. A good body has been opened, and it is expected that mining with three shifts will be started as soon as better ventilation has been provided. The Mammoth mine has paid dividends in the past amounting to $2,800,000, the last payment of $1 a share having been made in 1917. Recently the old mine dump was sold to the American Smelting & Refining Co., which is now taking this material to its smelters in Salt Lake valley, where it is a desirable constituent of the furnace charge.

Washington News

By Paul Wooton
Special Correspondent

Oppose Promotion of Foreign Trade in Lead and Zinc

Department of Commerce Discovers Fact by Sounding Industry on Suggested Plan — Would Conserve Supplies

Opposition to foreign trade promotion, by the Department of Commerce as applied to lead and zinc, is beginning to develop. The contention is that our dwindling deposits of these metals should be reserved for our own use.

New evidence of the existence of this feeling has been revealed in connection with informal inquiries as to the service which could be performed by a traveling mining trade commissioner. The view is held in many quarters that instead of trying to develop foreign trade in lead and zinc it would be better to be devising methods of conserving such of our supplies as remain.

Though the department does not subscribe to any such policy, the objections which have been registered against the stimulation of export trade in some of the major metals are regarded as significant. Some would extend this opposition to efforts looking to the discovery of new uses for these metals.

May Go to Straits to Buy Tin Direct

Independent Producers Would Short-Circuit London—Steel Corporation Has Singapore Office

Independent tin-plate manufacturers are considering action looking to the securing of some relief from the evils of unstable prices and from the exactions of London speculators. A meeting probably will be held in New York in the near future at which the matter will be discussed.

Consideration will be given at that time, it is expected, to a plan whereby the independents will establish an office in Singapore and make their purchases direct. The Steel Corporation for a long time has been buying in the Straits.

When purchases are made after the metal percolates through London the consumers frequently have to pay the artificial price resulting from speculation.

Secretary Hoover long has advocated concerted action on the part of consumers as the best way to fight a foreign monopoly.

Norway's Aluminum Industry Grows

According to statistics just published by the Norwegian Government, the production of aluminum has largely increased. The largest producers are the Norske Nitrit, Ltd., with an annual production of 12,000 tons, and the Norsk Aluminum Co., with an annual production of 7,000 tons. The first-named company has just increased its capital from 5,000,000 to 15,000,000 crowns and intends increasing its annual production to 15,000 tons.

The aluminum production of Norway has increased from 6,000 tons in 1913 to 22,000 tons in 1924, and Norway thus holds the second place among the aluminum-producing countries.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Lorrain Trout Lake Will Sink New Shaft

Canadian Pacific Has Eye on Flin Flon Copper Property—May Finance WAD Properties

Toronto, March 28.—Diamond drilling at the Lorrain Trout Lake property, in South Lorrain, 1,600 ft. south of the present shaft, has shown silver values where the drill hole crossed the Woods fault. It is understood the company will sink a new shaft in the vicinity of the drill hole and will carry it to about 400 ft. In addition to a recovery of high-grade ore, 100 tons of mill ore are being shipped daily to the Mining Corporation mill in Cobalt. The property is under the management of the Mining Corporation, which owns one-third of the stock. The annual report of the latter company will soon be issued and will show production from the old Cobalt properties greater than was anticipated; net profits, after all deductions, are understood to be approximately $65,000.

Developments at the South Lorrain property continue to be satisfactory, and the big Watson shoot discovered two months or so ago has now been proven for a length of 105 ft. From a raise put up in the oreshoot for a distance of 36 ft., approximately 100,000 oz. of silver was obtained. J. P. Watson, president, who is now in England, indicated that a dividend would soon be paid.

The Lorrain Trout Lake company also owns the big Flin Flon copper mine, in northern Manitoba, and there have been a number of rumors regarding negotiations for the disposal of the property to the Canadian Pacific Ry. It is believed that negotiations are not actually being carried on, but it is significant that the Canadian Pacific is gradually extending a line north in the general direction of this district. Approximately 200 miles has been built during the last two years, and the line is being gradually but steadily pushed forward. Officials no doubt have their eyes on the Flin Flon property, which would be a big tonnage producer for the railway company, which also controls the Consolidated Mining & Smelting Co. of British Columbia.

A. D. Miles, manager of the Anglo-Canadian Explorers, which is financed by John Taylor & Sons of London, and H. A. Wentworth, head of the "WAD" Syndicate, whose properties in central Manitoba have attracted so much attention, have sailed for England. It is understood that negotiations are being carried on for the purchase of a substantial interest in the "WAD" Syndicate holdings by the Anglo-Canadian Explorers. On the Kitchener claim, owned by the syndicate, a vein has been opened up for a length of 900 ft., with good ore at both ends and showing an average of $12 to $14 over a width of 5 ft.

The progress report of operations on the Walsh-Katrine mine, at Larder Lake, indicates encouraging conditions. Two levels have been opened up at 125 and 250 ft., and the No. 4 vein has now been cut in a crosscut from the 250 level. This vein was followed in the shaft for 50 ft. and showed a width of 8 ft., with values from $2.60 to $12.60. In cutting the station on the 250 level, high-grade ore was encountered. It is proposed to continue the development of the 250 level and in the meantime install heavier machinery, which will permit carrying on operations to 500 ft.

London Letter

By W. A. Doman
Special Correspondent

British Capital Seeks Investment in Base-metal Mines

Tin and Copper Properties Preferred—England's Consumption of Metals Exceeds Pre-War Figures

London, March 17.—At the annual meeting of shareholders of the Exploration Company, one of the members remarked upon the fact that the tendency of the directors in regard to investments was to withdraw funds from gold and silver mines and invest more heavily in base-metal properties. This is not confined to the Exploration Company, as other companies have adopted a similar policy. The object seems to be that as prices of the precious metals are more or less fixed, there is less possibility of profit than in mining the base metals when an advance in prices is looked for, and such advance means additional profit. As regards gold mines which are not, generally speaking, rich, profits are largely dependent upon a low level of working costs and large-scale operations, though the latter factor is sometimes illusory, the mills being used to treat low-grade ore when ore of a higher gold content could be crushed with better economical results. Tin- and copper-mining companies' shares are favored at the moment, in the belief that both metals will experience a greater demand at higher prices in the future. There is, of course, the counter-balancing fact that the increasing production may have the effect of lowering prices.

C. V. Sale, who is one of the leading authorities on metals and the chairman of the British Metal Corporation, expressed a hopeful view of the future at the meeting of shareholders last week. The consumption of copper, tin, lead, and zinc is now higher than before the war, though as regards copper it is wholly accounted for by the United States. There is, he said, no important new production of tin in sight, and he expects higher prices. Zinc is scarce,

and he looks for a maintenance of prices of both this metal and lead.

In connection with the recently mentioned issue of new capital by the Union Minière du Haut-Katanga, the Tanganyika Concessions now proposes to increase its capital from £3,500,000 to £5,500,000, of which 1,500,000 shares will be offered to the ordinary and preference shareholders at 22s. per share, in the proportion of three new shares for seven old. The objects of this increase are to take advantage of the company's right to acqupire 61,384 4½ per cent obligations of 100 francs each, 1,393 capital shares and 30,174 privileged shares, being the full proportion to which the company is entitled; to complete the Benguella railway to the Congo frontier; and to liquidate the company's liabilities and provide liquid cash assets so as to put the company in a dividend-paying position. This, it is stated, is to be the end of the Tanganyika financing. For many years it has been raising capital, either itself or through its associated company, the Zambesia Exploring Co., and shareholders will be pleased to learn that the end is in sight. The Benguella railway has been a big liability, but it is pointed out that another railway is an absolute necessity, as the Beira railway does not appear to be in a position to deal with the enormous traffic that will take place when the contemplated output of 200,000 tons of copper per annum is reached. As American interests have made a bid for Union Minière shares, the obligations have voting rights attached which will have the effect of always keeping the control in present hands.

Mohawk, in Michigan, Starts Second Regrinding Unit

Improves Recovery by 1 lb. per Ton—Good Ground Opened in No. 6 Shaft

Two heads in the Mohawk stamp mill, in the Michigan copper district, now are equipped with regrinding units, the second unit having been completed recently. The two remaining heads will be similarly equipped this year. It is expected the regrinding process will recover an additional pound of copper, or better, per ton of rock treated, which will bring Mohawk's tailing losses down to approximately 3½ lb. per ton. Careful note will be made of the effect of regrinding on rock from the different shafts, with a view to possible improvements. It will not be practicable to reclaim copper from the old tailing dumps, as the percentage of recovery would not meet the expense involved.

Splendid ground is being opened at depth in No. 6 shaft, Mohawk. The vein is well charged with copper and there is considerable mass. Mass copper constitutes 10 per cent of Mohawk's production, and the greater part of it comes from No. 6. A full program of development work is in progress in Nos. 6 and 1 shafts, Mohawk being well supplied with men. No. 1 ground continues comparatively lean, averaging about 18 lb. of refined copper per ton, compared with 22 or 23 obtained from rock from Nos. 6 and 4 shafts.

Johannesburg Letter

By John Watson

Special Correspondent

Jackhammers Increasing in Popularity on the Rand

Conciliation Board Recommends Wage Increase—New Platinum Fields Opened—Speculation Active

Johannesburg, Feb. 24.—A conciliation board was recently created to hear evidence regarding wages and condition in the gold-mining industry. The chairman of that board, Justice de Villiers, has recommended an increase in wages of twenty (20) per cent, retroactive to Oct. 1, 1924; and a revision of contract prices, with a 20 shillings per day guaranteed minimum. The decision is not binding upon any one, as there is no legal process by which the recommendations can be enforced. The effect of Judge de Villiers' recommendations on the Johannesburg Stock Exchange was to cause heavy liquidation of gold shares, until Friday afternoon, Feb. 21, when there was a slight reaction.

The thirtieth annual general meeting of the association of mine managers was held on Feb. 20, in the council room in the Chamber of Mines Buildings. The president, H. Mitchell, said in the course of his address that the most significant aspect of the last year's work had been the greatly extended use of jackhammer drills for stoping. The fathomage broken by these drills in the mines of the Central Mining and Investment group had increased from 35,456 in December, 1923, to 57,140 in December, 1924, and for the latter month 84½ per cent of the total fathoms broken on those mines was by jackhammers. The following new council of the association was elected: President, Paul Selby, Ferreira Deep; vice-president, C. B. Brodigan, Brakpan. Members, A. E. Payne, Van Ryn Deep; A. J. Walton, Crown Mines; C. S. McLean, West Rand Consolidated; F. G. Dunning, Simmer & Jack; S. Beaton, Nouose Mines; and A. A. Coaton, Springs Mines.

A new platinum venture—"De Kroon"—holding property in the Rustenburg district, was introduced on Feb. 20 on the Johannesburg Stock Exchange. The 5s. shares were largely dealt in at between 9s. and 11s. Another new platinum syndicate, Greenlands, Ltd., has been formed to operate in the Lydenburg district. The mineral rights of the farm Houtenbek, near Dullstroom, having been secured for £104,000. *The Government Gazette* issued on Feb. 20 announces that the Governor General will proclaim as public diggings for precious metals, the following farms, registered in the name of the government, situated in the district of Lydenburg, mining district of Pilgrims' Rest in the Transvaal Province: Driekop No. 170, Twyfelaar No. 172, Groothoek No, 171, Klipfontein No. 119, Brakfontein No. 84, Derde Gelid No. 141, Avoca No. 425, Schlichmanneckloof No. 12, De Kamp No. 469, Fesantlaagte, No. 421, Himalya No. 1, Middelpunt No. 20, Dingaanskop No. 431, Dsjate No. 334, Fernkloof No. 4, Quartzhill No. 440, Garatonev No. 467, Holpakrantz No. 5, Hoogstepunt No. 468, Nooitverwacht No. 137, and Soupiana No. 19.

Arizona Mining Companies Respond to "Trade at Home" Slogan

Figures recently given out by the Arizona Industrial Congress show that mining companies of the state, in accordance with the "Trade at Home; Use Arizona Products" movement, materially increased their purchases in Arizona during the last year. These purchases increased in variety as well as in amount. Purchases of mining purposes included powder, timber, castings, brooms, printing, and many items of equipment not listed in reports for previous years. Mercantile purchases covered a wide range of farm and manufactured products, butter, milk, meats, green vegetables, eggs, poultry, and flour being among the important farm products.

Of a total of $311,340.62 worth of Arizona products purchased by Inspiration Consolidated, $107,974.23 represented products originating on the farm. Total business placed in the state by the United Verde Copper Co. in 1924 totaled $933,937, against $544,706 for the year before. Old Dominion spent $161,533 in Arizona in 1924, compared with $94,073 for 1923. Ray Consolidated increased expenditures to $404,972 from $294,759.

Moore Mining Co. Discontinues Mill Operation

The Moore Mining Co., of Jackson, Calif., produced gross returns of $15,023 in January and $22,000 in February, including part of March. The mill has been shut down pending further development. The 1,200 level was opened up, but the vein was found to be faulted. O. H. Hershey, geologist, recommended drifting and crosscutting on this level to pick up the faulted vein. Further exploration will be made in an attempt to pick up the Zeila vein, and drifting will be done on the South Jackson vein on the 640 level.

New Stack at Trail Will Be 409 Ft. High

H. V. Arnold, constructional engineer for the Rust Engineering Co., of Pittsburgh, has arrived at Trail, B. C., to superintend the construction of the Consolidated Mining & Smelting Co.'s smokestack, which will be 409 ft. high and will have an inside diameter at the base of 25 ft. and at the top of 21 ft. 6 in. It will be built of reinforced concrete and will be lined throughout with brick. The foundation was laid last fall, but work had to be suspended on account of severe frosts. Mr. Arnold expects to have the stack finished within four months. The stack is to carry away the fumes from the new Wedge roasting furnaces, and between it and the furnaces the company is erecting a series of settling chambers for the deposition of flue dust.

Societies, Addresses, and Reports

San Francisco Section A.I.M.E. Elects Officers

The San Francisco Section of the A.I.M.E. met in San Francisco recently, Newton Cleaveland presiding. The new officers for the current year were announced: A. A. Hanks, chairman, Newton Cleaveland, vice-chairman, and E. W. Bullard, secretary-treasurer. The section went on record in approval of the legislative bill to curtail high grading and voted to accept the Institute's offer to establish an employment section at San Francisco. F. L. Sizer and Corey C. Brayton reported that they had attended a meeting of the legislative committee at Sacramento having the proposed Engineers' License Bill under consideration. Both section members urged that all local members send letters of protest against the bill.

Donald F. Young, manager of the American Manganese Steel Co., presented a short paper on the properties and manufacture of manganese steel. Corey C. Brayton enumerated the uses of manganese steel in the mining industry.

Stevens Receives John Fritz Gold Medal

The John Fritz gold medal was presented to John F. Stevens in the auditorium of the Engineering Societies Building, New York, on March 23. Presentation was made by the John Fritz Medal Board of Award representing the A.I.M.E., the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. Speakers were: Ralph Budd, president Great Northern Ry. Co., the Hon. Roland S. Morris, formerly Ambassador to Japan; and Mr. Stevens. John R. Freeman presided.

Engineers Discuss Their Fitness as Executives

"The Engineer as an Executive" was the topic for discussion at a joint meeting of the Metropolitan Sections of the four national engineering societies that was recently held at the Engineering Societies Building, New York. John P. H. Perry, president of the New York Section of the A.S.C.E., presided. The speakers were: Julius Kruttschnitt, chairman of the board of the Southern Pacific Ry. system, who talked on "The Engineer as a Railway Executive," and Samuel M. Vauclain, president of the Baldwin Locomotive Works.

Correlation of Lake Superior Geology Discussed

On March 13 and 14 a conference of Lake Superior geologists was held at the Department of Geology of the University of Wisconsin, at the invitation of Professor C. K. Leith, particularly to discuss problems of correlation in the Lake Superior region. In addition to the members of the Department of Geology, there were present at this conference Dr. W. H. Collins, Director of the Geological Survey of Canada; B. S. Butler, representing the U. S. Geological Survey; W. O. Hotchkiss, E. F. Bean, and H. R. Aldrich, representing the Wisconsin Geological and Natural History Survey; Professor F. F. Grout, representing the Minnesota Geological Survey; and T. M. Broderick, J. F. Wolff, C. J. Muller, M. C. Lake, Stephen Royce, H. M. Roberts, L. M. Schofield, V. D. Johnston, and H. N. Eidemiller, representing various iron- and copper-mining companies in the Lake Superior region.

Fellowships in Metallurgy

In co-operation with the U. S. Bureau of Mines and the State Mining Experiment Station, the School of Mines and Metallurgy of the University of Missouri is offering four fellowships. These are open to graduates who have the equivalent of a bachelor of science degree and have had the proper training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is $800 per annum for the twelve months beginning July 1, 1925. Fellows pay fees amounting to approximately $30 per year. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of Missouri.

For 1925-26 the four fellowships will be granted in the following subjects: Metallurgy of Zinc, Refractories for Metallurgy of Zinc, Physical Metallurgy (heat treatment of steel.)

American Refractories Institute Planned

It is announced that tentative plans have been made for the organization of a bureau to be named "The American Refractories Institute." One of the main purposes of this Institute will be to provide a satisfactory means for contact between representatives from all the industries that use and manufacture refractories, so that their various economic and technical problems with respect to heat-resisting materials may be thoroughly considered and efforts be made to solve these problems. It is proposed to maintain a research laboratory, wherein outstanding problems will be studied. These problems will be those of the consumer, as well as of the manufacturer.

A meeting is to be held in Pittsburgh, Pa., on April 14, when final plans for incorporation of the Institute will be discussed. Representatives of industrial firms that use refractories have been invited to attend this meeting.

Macdonald C. Booze, senior incumbent of the Multiple Industrial Fellowship on Refractories, Mellon Institute of Industrial Research, Pittsburgh, has been appointed temporary secretary of the organizing committee.

Atomic Weights Up to Date

In the accompanying table, taken from the Feb. 6, 1925, issue of *Chemistry and Industry*, are given the atomic weights of the chemical elements as issued for 1925 by the International Union of Pure and Applied Chemistry.

Table of Atomic Weights of the Chemical Elements Issued by the International Union of Pure and Applied Chemistry, 1925

	Symbol	Atomic Number	Atomic Weight
Aluminum	Al	13	26.97
Antimony	Sb	51	121.77
Argon	A (Ar)	18	39.91
Arsenic	As	33	74.96
Barium	Ba	56	137.37
Beryllium	Be	4	9.02
Glucinium	Gl		
Bismuth	Bi	83	209.00
Boron	B	5	10.82
Bromine	Br	35	79.916
Cadmium	Cd	48	112.41
Cæsium	Cs	55	132.81
Calcium	Ca	20	40.07
Carbon	C	6	12.000
Cerium	Ce	58	140.25
Chlorine	Cl	17	35.457
Chromium	Cr	24	52.01
Cobalt	Co	27	58.94
Columbium	Cb	41	93.1
Niobium	Nb		
Copper	Cu	29	63.57
Dysprosium	Dy	66	162.52
Erbium	Er	68	167.7
Europium	Eu	63	152.0
Fluorine	F	9	19.00
Gadolinium	Gd	64	157.26
Gallium	Ga	31	69.72
Germanium	Ge	32	72.60
Gold	Au	79	197.2
Helium	He	2	4.00
Holmium	Ho	67	163.4
Hydrogen	H	1	1.008
Indium	In	49	114.8
Iodine	I (J)	53	126.932
Iridium	Ir	77	193.1
Iron	Fe	26	55.84
Krypton	Kr	36	82.9
Lanthanum	La	57	138.90
Lead	Pb	82	207.20
Lithium	Li	3	6.940
Lutecium	Lu	71	175.0
Magnesium	Mg	12	24.32
Manganese	Mn	25	54.93
Mercury	Hg	80	200.61
Molybdenum	Mo	42	96.0
Neodymium	Nd	60	144.27
Neon	Ne	10	20.2
Nickel	Ni	28	58.69
Nitrogen	N	7	14.008
Osmium	Os	76	190.8
Oxygen	O	8	16.000
Palladium	Pd	46	106.7
Phosphorus	P	15	31.027
Platinum	Pt	78	195.23
Potassium	K	19	39.096
Praseodymium	Pr	59	140.92
Radium	Ra	88	225.95
Radon	Rn	86	222.
Rhodium	Rh	45	102.91
Rubidium	Rb	37	85.44
Ruthenium	Ru	44	101.7
Samarium	Sm	62	150.43
Scandium	Sc	21	45.10
Selenium	Se	34	79.2
Silicon	Si	14	28.06
Silver	Ag	47	107.880
Sodium	Na	11	22.997
Strontium	Sr	38	87.63
Sulphur	S	16	32.064
Tantalum	Ta	73	181.5
Tellurium	Te	52	127.5
Terbium	Tb	65	159.2
Thallium	Tl	81	204.39
Thorium	Th	90	232.15
Thulium	Tm	69	169.4
Tin	Sn	50	118.70
Titanium	Ti	22	48.1
Tungsten	W	76	184.0
Wolfram			
Uranium	U	92	238.17
Vanadium	V	23	50.96
Xenon	Xe	54	130.2
Ytterbium	Yb	70	173.6
Yttrium	Y	39	88.9
Zinc	Zn	30	65.38
Zirconium	Zr	40	91.0

Welders to Meet

On April 22-24, the American Welding Society will hold its annual meeting in New York in the Engineering Societies Building. The business session is set for the morning of April 23. That evening the annual dinner will be held at the Park Avenue Hotel.

Men You Should Know About

A. W. Newberry, of New York, is making a tour of the important mining districts in Arizona and Nevada.

John Curran, of Walker, Ariz., is in New York seeking to interest capital in a property that he has at Walker.

Louis D. Huntoon, consulting mining engineer, of New York City, has opened a Toronto office at 156 Yonge St., that city.

Dr. Rudolf Gahl is to visit Europe. He will leave New York early in April, and expects to return to Berkeley, Calif., in August.

Royden C. Philpott, superintendent of the Cerro division, Cerro de Pasco Copper Corporation, is visiting mines in Arizona.

George P. MacKenzie, gold commissioner for Yukon Territory, has left Ottawa, where he spent the winter on territorial business, for Dawson City.

H. I. Altshuler, of the San Luis Mining Co., San Dimas, Dgo., Mexico, is in San Francisco convalescing from a broken arm, the result of a fall in a winze at the mine.

Nelson Dickerman, consulting mining engineer, of San Francisco, who recently went to Chile on professional business, has been detained in that country and will not reach New York before the middle of April.

C. W. Adams, who recently came to San Francisco as assistant to E. B. Braden, general manager of the Selby plant of the American Smelting & Refining Co., has been appointed manager of the plant, **E. B. Braden** advancing to the advisory board of the American Smelting & Refining Co. Mr. Braden has been general manager of the company's business in California for more than twenty years. Mr. Adams was manager of the East Helena plant for five years and before that time was at the Murray plant, in Utah. With the appointment of Mr. Adams, the Selby plant comes under the jurisdiction of **H. Y. Walker,** who is now in charge of operations of all of the western plants of the American Smelting & Refining Co.

C. W. Adams

J. H. Stovel, superintendent of the mining division of the Longyear Company, at present established in Caretta, W. Va., is visiting his family in Toronto, Canada.

Matthew van Siclen, Dr. R. R. Sayers, and **H. I. Smith,** of the U. S. Bureau of Mines, are at Miami, Okla., in connection with the Bureau activities in the Tri-State zinc and lead district.

Charles P. Berkey, professor of geology at Columbia University, and **Frederick Morris,** geologist, recently sailed from San Francisco for China with the 1925 expedition sent out by the American Museum of Natural History, in New York. They will conduct field investigations in China and Mongolia, under the direction of **Roy Chapman Andrews.**

W. R. Rogers, who has been appointed Acting Deputy Minister of Mines for Ontario during the illness of Thomas W. Gibson, is a graduate of the

W. R. Rogers

School of Mining, now the Science Faculty of Queens' University, Kingston, Ont. He joined the staff of the Ontario Department of Mines in 1907 and has since, with the exception of one year, been continuously in the service.

A. J. King, who had left Sydney in 1913 as general manager of the Austral-Malay Tin, Ltd., and the Kampong-Kamunting Dredging Co., in Malaya, has returned to Australia, and was recently in Melbourne. He is now managing director of the Nawng Pet Tin, Ltd., and the Huey Yot Tin Dredging Co., at Taiping.

Arthur E. Bendelari, vice-president of the Eagle-Picher Lead Co., and in charge of mines in the Joplin-Miami field, with headquarters at Joplin, has been promoted to the position of vice-president and treasurer, with offices in Chicago. He will succeed **Thomas S. Brown,** who is retiring on account of bad health. Mr. Bendelari is also president of the American Zinc Institute. **George Potter,** who has been superintendent of mines under Mr. Bendelari, has been promoted to a vice-presidency of the company, and succeeds to the management of the Joplin-Miami field.

J. Egerton Wood

J. Egerton Wood, consulting mining engineer, after an extended tour through the Dutch East Indies on professional business, has returned to Bandoeng, Java.

James P. Porteus, of Lordsburg, N. M., has returned to London, having completed examinations in Portugal, French Morocco, and western Algeria. An effort to get into Spanish Morocco was made, but was unsuccessful owing to the activity of the Abd el Krim forces. A photographic survey was made by airplane, however, of the area between Tangiers and Rabat, and also between Tangiers and Fez.

Obituary

Newman Erb, president of the New Dominion Copper Co., railroad president and financier, died in New York on March 25. Mr. Erb was seventy-four years old.

Willis Dye, foreman at the 4C mine, at Cananea, Sonora, Mexico, was killed on March 14 as a result of a fall down a winze. He missed his footing as he was going down a ladder and fell 25 ft., landing on an ore bucket. He was brought to the surface still breathing but unconscious, and died a few hours later.

William A. Haswell, a distinguished geologist, died recently in Sydney, New South Wales, Australia, at the age of seventy-one. He was formerly curator of the Queensland National Museum, and subsequently engaged in a zoological cruise on the Queensland coasts. Dr. Haswell was born in Edinburgh, and was educated at the Edinburgh Institution and University, where he was a Baxter scholar. He arrived in Australia in 1879, and in 1882 became demonstrator of zoology, comparative anatomy, and histology in the Sydney University. In the same year he was acting curator of the Australian Museum, and also occupid the position of professor of biology in the University of Sydney from 1890 to 1914. In 1915-17 he was professor of biology, and in 1918 Emeritus Professor of Geology, at the Sydney University. He was likewise president of the Linnean Society of New South Wales in 1892-93, and became a F.R.S. in 1897.

Recent Technical Publications

Reviews, Abstracts, and References

Washington Lead Deposits

Lead Deposits of Pend Oreille and Stevens Counties, Washington. By Olaf P. Jenkins, State of Washington, Department of Conservation and Development, D. A. Scott, Director; Division of Geology, Solon Shedd, Supervisor.

This is an excellent report on the lead deposits of northeastern Washington, in which the principal producer is the Gladstone mine. Washington ranked eleventh among the lead-producing states of the United States in 1923; the United States produces nearly three times as much lead as any other country, yielding three-sevenths of the world's total production.

The report is mainly geological, descriptive, and statistical. For its straightforward, common-sense style of writing and its simplicity of treatment, it is much to be recommended; in this respect it resembles publications like those of the Geological Survey of Ontario, which have proved so well adapted to the public need and so clear in their scientific statements. Too often the more voluminous geological reports of certain geological surveys (including some of the United States Geological Survey) have grown long-winded, obscure, and pedantic. They remind one of the darkey who complained to the court that his wife talked incessantly. "What does she talk about," asked the judge. "That's jest the trouble, jedge," was the reply. "She doan't say." J. E. SPURR.

Analyzing Chance

Risk and Risk Bearing. By Charles O. Hardy. University of Chicago Press, Chicago, Ill. Price $3.50.

Only a moment's reflection is required to realize the highly important part which the element of uncertainty plays in business. Uncertainty about prices, markets, labor supply, war, and uncertainty about one's own employment combine to make the businessman's lot a troublesome one. In this book an attempt is made to segregate and analyze these uncertainties and risks, to weigh them and to indicate the methods by which they may be borne or guarded against. In other words, the insurance that may be had as protection, and how it works, forms the sum and substance of the text.

Although a knowledge of economics is desirable and helpful in reading and studying Professor Hardy's remarks, he has handled his subject so clearly and skilfully that this reviewer fails to see why anyone seriously interested in the subject should not derive great benefit from a study of the book. The function of the speculator—in itself a fascinating subject about which much misinformation is current—is scientifically discussed by the author, and we find that, in his proper sphere, the speculator is not the low creature the average person thinks and that he performs a task in our economic system that is indeed quite valuable. It is mainly owing to his activities that such useful protection against price declines known as "hedging" can be taken. Business forecasting, stock speculation, and the analysis of securities furnish subjects for other interesting chapters in the text. The latter section of the book treats of life and fire insurance, the risks of labor and the social aspects of speculation. We found the reading and study of this work a pleasant and fruitful occupation. F. E. WORMSER.

How to Conduct Sales Campaigns

Constructive Merchandising. By Robert E. Ramsay. D. Appleton & Co., New York. Price, $6.

That this is an up-to-the-minute book on selling technique may be grasped from the fact that it discusses the use of the radio (at $400 per hour and $100 for ten minutes) in sales campaigns, along with the use of the many other weapons at the disposal of the well-equipped salesman. The author has made the object of his work the presentation of effective plans for increasing sales, and has brought to his task many diagrams and photographs in a demonstration of how to sell most effectively. He also takes up the function of the numerous mediums through which the producer may give his message to prospective consumers. It is a book that can be studied with profit by anyone having a product to market.

The Practice of Importing

Principles of Importing. By Wayne E. Butterbaugh. D. Appleton & Co., New York. Price $5.

The beauty of this book lies in its careful attention to detail. The average text on exporting and importing confines itself generally to the broader aspects of foreign commerce, so that technique and routine are subordinated. Professor Butterbaugh's work fills this void excellently. A person totally unfamiliar with the documentary machinery used and procedure necessary to import commodities into the United States will find the entire subject taken up step by step in the book, clearly and thoroughly. The author discusses the many ramifications of importing, from the actual purchase of the goods abroad to the filling out of the shipping documents, shipping practice, government regulations, clearance through customs, and, last but not least, the problems of domestic distribution or marketing. It is a painstaking and valuable volume liberally illustrated with examples from practice. In fact, it would have been quite appropriate to entitle the book, the practice of importing rather than principles. The appendix contains a useful number of tables giving trade terms and definitions. To anyone interested in the importations of mineral commodities the book is to be highly recommended.

F. E. WORMSER.

Economic Geology—*Economic Geology* for December (Lancaster, Pa.; price 65c.) contained the following papers: "The Pegmatites," 27 pages, by James F. Kemp; "Supergene Enrichment of Copper below Lean Pyritic Zone," 6 pages, by Charles White; "Rôle of Heavy Minerals in the Coalinga Tertiary Formations," 20 pages, by R. D. Reed; "Pre-Cambrian Complex and Pyrrhotite Bands, Dusky Sound, New Zealand," 6 pages, by James Park; and "Geology and the Location of Dams in West Texas," 6 pages, by Leroy T. Patton. The March-April issue contains: "The Camp Bird Compound Veindike," 38 pages, by J. E. Spurr; "Notes on Southern Trinidad," 15 pages, by Charles G. Carlson; "Diagnostic Value of Color in Polished Sections," 13 pages, by Sterling B. Talmadge; "An Apparent-dip Protractor," 4 pages, by W. S. Tangier Smith; and "Molybdenite, New Ross, Nova Scotia," 4 pages, by Charles W. Cook.

Molybdenum Deposits—Bulletin 761 of the U. S. Geological Survey, by Frank L. Hess, is a short review of the molybdenum deposits of the world, accompanied by maps and photographs of specimens of molybdenite. The largest reserves are in the United States. A copy of the bulletin may be obtained from the Superintendent of Documents, Washington, D. C., for 15c.

Igneous Rocks—"A Proposed Classification of Igneous Rocks" is offered by Edwin T. Hodge in a 72-page bulletin of the University of Oregon. The paper is an attempt to formulate a classification of igneous rocks based upon their mineral composition and chemical character, in a quantitative manner. Copies are obtainable for $1 each from the University Press, University of Oregon, Eugene, Ore.

Screen Tests of Fine Material—What does a fineness of 450 mesh mean? Raymond B. Ladoo has a four-page article on the screen testing of fine powders in *Chemical and Metallurgical Engineering* for Oct. 20 (New York; price 25c.)

Brinell Hardness—The U. S. Bureau of Standards has published a convenient table for converting the diameter of Brinell impressions to Brinell hardness numbers. Obtainable for 5c. from the Superintendent of Documents, Washington, D. C., this being Miscellaneous Publication No. 62 of the Bureau of Standards.

Mineral Resources—Recent separate chapters of "Mineral Resources of the United States, 1923," include: "Natural Gas," 8 pages, by G. B. Richardson; "Gold, Silver, Copper, Lead, and Zinc in Arizona," 34 pages, by V. C. Heikes; "Gold, Silver, Copper, Lead, and Zinc in Montana," 33 pages, by C. N. Gerry; "Gold, Silver, Copper, Lead, and Zinc in Utah," 29 pages, by V. C. Heikes; and "Gold, Silver, Copper, Lead, and Zinc in Nevada," 34 pages, by V. C. Heikes. All obtainable on request from the U. S. Geological Survey, Washington, D. C.

California Copper—The "Copper Resources of Shasta County," are described by W. B. Tucker, 28 pages, in the October issue of *Mining in California*, published by the California State Mining Bureau, San Francisco.

Canadian Mining Publications

The report of the Canadian Department of Mines for the fiscal year ended March 31, 1924, is now available for 15c. from the department at Ottawa. Its 71 pages contain a brief summary of the department's activities during the year. The summary report, 1923, Part CI, of the Canadian Geological Survey, obtainable on request to the Survey at Ottawa, contains the following papers: "Iron Formation at Gravel Lake, Thunder Bay District," 5 pages, by T. L. Tanton; "Recent Discoveries of Radioactive Minerals in Ontario," 15 pages, by H. V. Ellsworth; "Geology of a Portion of the Northern Part of Moose River Basin, Ontario," 21 pages, by E. M. Kindle; "Character and Origin of the Ore Deposits, Argonaut Gold Mine, Ontario," 19 pages, by H. C. Cooke; "Recent Gold Discoveries at Larder Lake, Ontario," 13 pages, by H. C. Cooke; "Some Gold Deposits of Western Quebec," 50 pages, by H. C. Cooke; "Rouyn Map Area, Quebec," 19 pages, by W. F. James; and "Dufresnoy Map Area," 6 pages, by Robert Harvie. Part CII contains: "Copper Prospects in Gaspe Peninsula, Que.," 12 pages, by F. J. Alcock; and three coal and peat papers. Part B contains: "Mackenzie River Area," 15 pages, by G. S. Hume; "Clay Deposits of Athabasca River, Alberta," 5 pages, by G. S. Hume; "Geology and Mineral Prospects of the Northern Part of Beresford Lake Map Area, Southeast Manitoba," 19 pages, by J. F. Wright; and two papers on Alberta coal.

To one who wishes to become acquainted with the various activities of the Canadian mining industries we recommend the article by R. P. D. Graham in the *Bulletin* of the Canadian Institute of Mining and Metallurgy for November, "Mines and Mineral Deposits of Canada," 115 pages. (Drummond Building, Montreal; price 50c.) This article was the official contribution of the Institute to the Empire Mining and Metallurgical Congress held in London last June.

"The Goldfields of Northwestern Quebec" are discussed by W. B. Timm and A. H. A. Robinson in Bulletin No. 20, Memorandum series, obtainable free from the Department of Mines, Ottawa. The report tells how the ore occurs, which are the most promising discoveries, and suggests methods of treatment for the ore.

Those interested in Canadian nonmetallic minerals should read "Some Canadian Non-metallic Minerals; a Review of Fifteen Years' Progress," in the March *Bulletin* of the Canadian Institute of Mining and Metallurgy (Drummond Building, Montreal; price 50c.). The particular minerals whose technologic and economic status is described are natural abrasives, sodium and magnesium salts, silica, feldspar, mica, graphite, barytes, talc and soapstone, and asbestos.

The copper and nickel deposits of Manitoba are also described in the bulletin just mentioned. The February bulletin contains a list of the members of the Institute.

"Clay and Shale Deposits of Ontario," by John Keele, 176 pages, has recently been published by the Geological Survey, Ottawa, as Memoir 142, price 25c. The bulletin contains descriptions of the different clays and shales, their occurrence, properties, and uses, with notes on methods of testing.

In Bulletin No. 21, Memorandum series of the Department of Mines, Ottawa, obtainable on request, C. S. Parsons discusses the concentration of the lead-zinc ores of eastern Canada, with results of laboratory tests employing selective flotation. In Bulletin No. 617, "Investigations in Ore Dressing and Metallurgy," reports of a large amount of laboratory work in selective flotation are given, and there is also a chapter on the beneficiation of Canadian iron ores, followed by brief descriptions of several Canadian ore-concentration plants.

Bulletin No. 616 of the Department of Mines, Ottawa, also obtainable on request, "Investigations of Mineral Resources and the Mining Industry, 1923," has chapters on bentonite, feldspar, the bituminous sands of northern Alberta, natural abrasive materials in Canada, natural gas in Alberta, sodium and magnesium salts of western Canada, and zinc-lead mining in British Columbia.

Patents

Concentrating Table—No. 1,527,450. Feb. 24, 1925. A. H. Stebbins, Los Angeles, Calif. A riffled concentrating table for dry pulp, with apertures in the deck through which air can be blown.

Electrolytic Process—No. 1,527,526. Feb. 24, 1925. Richard Rodrian, New York City, assignor to Hans Adelmann, New York. Metal-bearing material is brought in contact with a solution of caustic alkali, and the mass electrolyzed over a layer of mercury.

Petroleum Drilling

No. 1,527,713. Feb. 24, 1925. F. M. Stout, Tulsa, Okla. A sucker-rod protector.

No. 1,528,145. March 3, 1925. E. N. Davidson, Breckenridge, Tex. A combination tubing socket.

No. 1,528,710. March 3, 1925. H. C. Van Houten, Topeka, Kan. An oil-well fishing tool.

Reissue No. 16,018. March 10, 1925. Wallace Canfield, Taft, Calif. A gas clamp for oil-well casings.

No. 1,529,848. March 17, 1925. G. R. Reeder, Danbury, Tex. A casing cutter.

No. 1,529,874. March 17, 1925. E. A. Culbertson, Wichita, Kan. Improvements in casing, drill rod, and stuffing box connections.

No. 1,529,924. March 17, 1925. J. W. Sandlin, Humble, Tex. A pump valve.

No. 1,530,221. March 17, 1925. Lester C. Uren, Berkeley, Calif. A process and apparatus for increasing the recovery of petroleum from wells by the introduction of insoluble granular material within a cavity surrounding a well shaft.

No. 1,530,553. March 24, 1925. L. A. Gilmore, Denoya, Okla. An oil-well swab.

No. 1,530,624. March 24, 1925. W. T. Smith, Los Angeles, Calif. A method of and apparatus for pumping sand-laden oil wells.

No. 1,530,636. March 24, 1925. E. E. Anderson and J. G. Bouslog, Brea, Calif. A tool for cutting and removing pipe from wells.

Arsenic Recovery — No. 1,528,004. March 3, 1925. H. P. Bassett, Cynthiana, Ky., and S. S. Sadtler, Springfield Township, Montgomery Co., Pa. Ores containing arsenic associated with sulphur and heavy metals are heated in the presence of a limited amount of air insufficient to oxidize the sulphur present, whereby arsenious oxide is formed.

Ore Roasting—No. 1,528,155. March 3,1925. William Lanyon, St. Louis, Mo. A rotating roasting chamber with refractory lining, through which a limited amount of highly heated air passes, means being provided for regulating the amount, temperature, and pressure of the air.

Hydrometallurgy — No. 1,528,204. March 3, 1925. William E. Greenawalt, Denver, Colo. An apparatus for saturating a liquid with a gas. No. 1,528,-205 covers the leaching of copper ore, first with an acid solution low in ferric iron, then with an acid high in ferric iron, and separately precipitating the copper from both solutions. No. 1,528,-206 covers means for the saturation of liquid with a gas. No. 1,528,207 covers leaching copper ore with a chloride solution, chemically precipitating the copper with the simultaneous regeneration of acid, then applying gaseous chlorine to the solution and returning it to the ore. No. 1,528,208 covers an electrolytic cell with carbon anodes and metal cathodes. No. 1,528,-209 is a cyclic process for roasting and leaching copper ore, with electrolytic precipitation of the copper.

Crusher — No. 1,528,316. March 3, 1925. Richard Bernhard, Allentown, Pa., assignor to Traylor Engineering & Mfg. Co., Allentown, Pa. Design for a jaw crusher.

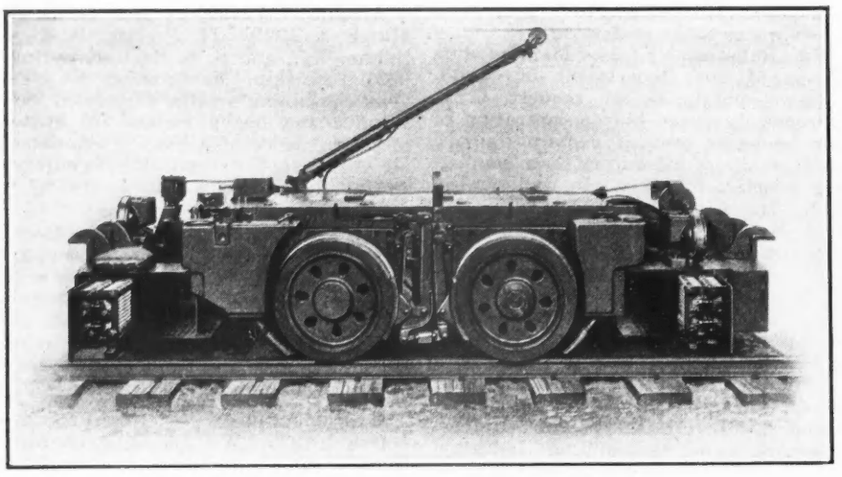
No. 1,528,741. March 3, 1925. W. S. Weston, Columbia, S. C., assignor to Weston & Brooker, Columbia, S. C. Design for a gyratory crusher.

Titanium Recovery — No. 1,528,319. Georges Carteret, Boulogne, and Maurice Devaux, Paris, France. A cyclic process for treating titanium ores containing iron for the production of titanium oxide pigment. The ores are heated in a reducing atmosphere, successive currents of halogen gas passed through the ore mass, in opposite directions and at different temperatures, whereby the iron and titanium halogen compounds are volatilized; after which the halogen gas is regenerated.

Oxidized Ore Treatment—No. 1,528,-716. March 3, 1925. G. H. Wigton, Eureka, Utah. Finely ground oxidized lead-silver ore is agitated in an electrolyte in the presence of a finely divided metal electro-positive with respect to the metal of the ore, and the metal content concentrated.

Rabble Arm—No. 1,529,256. March 10, 1925. L. R. Kelley, Bethlehem, Pa., assignor to Bethlehem Foundry & Machine Co. A rabble arm, with inside air channels, for mechanical roasting furnaces.

New Machinery and Inventions



Handy Pockets Make Resistors Easily Accessible

The resistance is hung on a hinged door which may be readily opened for inspection. With this arrangement it is easy to keep the resistance in repair and the locomotive operating properly

Pockets in Side Frame Hold Locomotive Grid Resistor

With small haulage and gathering locomotives built to provide low headroom it is difficult to find a convenient location for a resistor of large capacity, especially in view of the fact that it must be readily accessible for inspection. The accompanying illustration shows how the difficulty has been solved by the Jeffrey Manufacturing Co.

In designing its standard outside-wheel type of haulage and cable-reel locomotives in 4-, 6- and 8-ton sizes, it uses three pockets in the side frame for mounting sections of resistance. The two sections are bolted to a hinged door, which when closed protects the resistor from injury. When the resistor is to be inspected or repaired it is only necessary to open the door of the pocket.

The special cast-alloy iron-grid resistor is standard for all Jeffrey locomotives. The grids are cast with the greater section of the metal parallel with the supporting rods, reducing vibration to a minimum.

The combination of these large current capacity grids with large diameter supporting rods, heavy malleable iron end plates and liberal brass-clamp connectors makes a thoroughly practical resistance for mine service.

A Metallic Lead Paint

A new lead paint, known as "Subox," which has rather interesting qualities, has recently made its appearance on the American market after having been introduced abroad. It consists of a colloidal suspension of suboxide of lead (Pb_2O) in boiled linseed oil, according to the New York agent (Subox, Inc., or the E. T. Eberhardt Co., 874 Broadway), the suboxide having been prepared by a special process and being in a state of extremely fine division. In *Chemical and Metallurgical Engineering* of Nov. 17, 1924, p. 775, and Feb. 16, 1925, p. 293, it is described as a colloidal suspension of metallic lead in boiled linseed oil. It is claimed by the agent, however, that eventually the linseed oil oxidizes, reducing the suboxide to metallic lead. Whatever the process, the result is a durable coating of metallic lead within six to eight months after the Subox is applied to the surface that it is intended to protect, according to the manufacturer. Samples of coated surfaces, of various ages, seem to confirm this statement. The surface becomes hard within several weeks after application, though months are required to complete the process, as stated above.

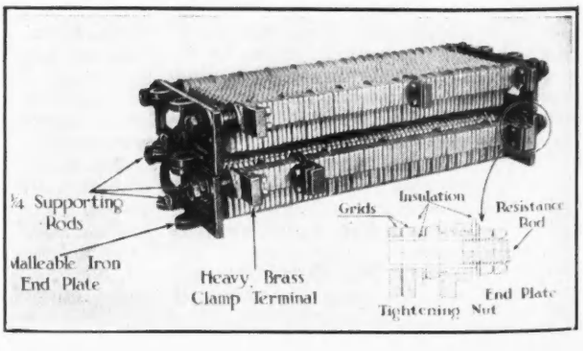
The new paint is intended as protection against air, gases, and acids. Remarkable claims as to its resisting and protective quality are made, so that it will be interesting to watch for the results of its use. Atmospheric air, it is said, is necessary for the proper development of the hardened surface of metallic lead.

The Fahrenwald Classifier

In the article describing the Fahrenwald constant-density classifier, which appeared on p. 506 of the *Mining Journal-Press* of March 21, 1925, a statement to the effect that A. W. Fahrenwald's official title is "ore-dressing engineer, U. S. Bureau of Mines," was omitted. The classifier, Mr. Fahrenwald states, is the result of a co-operative investigation by the U. S. Bureau of Mines, the Idaho School of Mines, and the Bunker Hill & Sullivan Mining & Concentrating Co.

High Capacity Grids Built for Heavy Service

In the lower right-hand corner of the sketch is shown a threaded bushing which is used to tighten the grids. Thus the length of the sections remains the same.



Trade Catalogs

Bucket Elevators — Catalog 410 of the Jeffrey Manufacturing Co., Columbus, Ohio, features a line of standardized elevators for service in sand and gravel plants, quarries, cement mills, power houses, and wherever loose materials are to be handled.

Screens — Universal mechanical vibrating screens are covered in Catalog No. 50, 24 pages, illustrated, just issued by the Universal Vibrating Screen Co., Racine, Wisconsin. The vibration is effected in this screen by two off-center weights mounted on a shaft that rotates at 1,800 r.p.m.

Gravel Wall Wells—A new folder describing the Layne gravel-wall well has been issued by Layne & Bowler Co., of Memphis, Tenn.

Welding — "G. E. Welding Electrodes" is the title of a small 16-page illustrated booklet just issued by the General Electric Co. It describes the characteristics and applications of the three types of G. E. electrode, designated as types A, B, and C. Brief instructions are given covering the use of each type.

Cranes — "Electric Equipment for Cranes" is a General Electric bulletin, No. 48,732, recently issued. This is a 35-page leaflet, well illustrated with photographs, diagrams, tables and charts. It discusses the subject thoroughly, with particular reference to crane motors and control, brakes, and other equipment. Information is given on operating characteristics, and types of standard motors are listed, together with numerous other valuable data.

Hand Stokers — Catalog No. 60-R, issued by the Marion Machine Foundry & Supply Co., Marion, Ind., describes the Marion line of hand stokers.

Speed Reducer—The Lipe speed reducer, made under the Tyler patents, is described in a 6-page folder issued by W. C. Lipe, Inc., 208 South Geddes St., Syracuse, N. Y. Its gear ratio is 4:1 to 200:1. Maximum load, 500 hp.

Cutter Chains—A 40-page book of instructions for users of cutter chains, as applied to mining machines, used for cutting in coal or salt, has been issued by the Goodman Manufacturing Co., Halsted St. and 48th Place, Chicago, Ill. The material for this book has been collected for many years from field and laboratory reports, it is said. It has been compiled in an effort to enlighten mining machine users on a detail which is directly or indirectly responsible for the greatest amount of machine troubles.

The Market Report

Daily Prices of Metals

Mar. Apr.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
26	13.625@13.75	53.25	54.125	8.75	8.40	7.325@7.35
27	13.45	52.25	53.125	8.65@8 75	8.25@8.40	7.20@7.25
28	13.25	52.00	52.875	8.55@8.75	8.20@8.25	7.20
30	13.20	51.50	52.25	8.40@8.50	8.05@8.125	7.00
31	13.25	51.625	52.375	8.40@8.50	8.05@8.10	6.95@7 00
1	13.375	52.00	52.75	8.35@8.50	8.00@8.10	7.05@7.125
Av.	13.369	52.104	52.917	8.571	8.194	7.138

*The prices correspond to the following quotations for copper delivered: March 26th, 13.875@14c.; 27th, 13.70c.; 28th, 13.50c.; 30th, 13.45c.; 31st, 13.50c.; April 1st, 13.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Mar. Apr.	Copper			Tin		Lead		Zinc	
	Standard		Electro-lytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
26	62	63	66½	247¼	250½	36⅛	34 9/16	36½	34¾
27	61	62⅛	65¾	244½	248	35½	33⅞	36	34⅝
30	60⅜	61½	64¼	240¼	244	35	32⅞	34⅞	33¾
31	60⅛	61¼	64	235½	239¼	34⅞	32⅞	34¾	33¼
1	61⅜	62⅛	65	240¼	243¾	34⅝	33¼	34½	33¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver		Gold London	Mar. Apr.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
26	4.78⅛	67⅜	31⅝	86s 5d	30	4.77½	67⅜	31¾	86s 6d
27	4.77¾	67¼	31⅝	86s 5d	31	4.77¼	67⅛	31 11/16	86s 7d
28	4.77¼	67⅜	31 13/16	.....	1	4.77⅜	66⅞	31½	86s 6d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for March, 1925

Copper:	
New York Electrolytic	14.004
London Standard	62.892
London Electrolytic	67.739
Lead:	
New York	8.914
St. Louis	8.578
London	36.804
Silver:	
New York	67.808
London	31.935
Sterling Exchange	477.279
Zinc:	
St. Louis	7.319
London	35.741
Tin:	
99 per cent	53.038
Straits	53.733
London	245.682
Quicksilver	80.481
Antimony	15.553
Platinum:	
Refined	117.000
Crude	115.000

Metal Markets Have the Poorest Week of the Year

New York, April 1, 1925—The principal non-ferrous metals received violent setbacks during the past week, carrying them to new low levels for the year. Behind the movement was the strong downward tendency of the London metal market and the efforts of speculators to drive prices lower. Today most of the metals look better and have recovered some of the ground lost. The demoralized condition of the markets prevailing earlier in the week has now disappeared.

No Resistance to a Declining Copper Market

Copper is back to where it was last October. During the last six days the price of the metal dropped a full half cent per lb.—a sharp decline, but not unusual for copper. Except for some good business last Thursday and Friday, sales were light on the decline. A few producers did not sell a pound of copper in the domestic market. Whereas the consumer could not do better than 13⅞c. per lb., delivered, last Thursday, a succession of drastic daily revisions of the price here, in sympathy with a falling London market, brought the market down as low as 13⅜c. on Monday. Consumers failed to cover at this level, however, probably anticipating still easier prices. In the meantime the market has reacted upward, a sale being made today at 13⅝c., which is the asking price of most producers. Sales reported to us for the week totaled about 22,000,000 lb. in the domestic market. Export demand has been quiet.

Lead Declines Sharply

The contract price for New York lead, set by the American Smelting & Refining Co., was reduced from 9 to 8.75c. on Thursday, March 26, and to 8.50c. on Monday, March 30.

The declines in lead prices here have been brought about chiefly by the weakness in London, which would have resulted in the free entry of ore lead from Mexico had not prices here been reduced. Consumers, naturally, have not been inclined to buy heavily, preferring to wait until the decline has run its course, unless absolutely bare of stocks. Like last week, most of the orders have been for small tonnages and for prompt shipment. Should the market turn stronger, producers expect to be swamped with orders, so, as they have no great stocks on hand, they are not inclined to press metal for sale. There is more pressure to sell in St. Louis than here, with the result that St. Louis prices have been below what might be expected considering the freight differential between the two markets. On Saturday, for example, lead was offered in St. Louis as low as 8.20c., though no Eastern seller was willing to take less than 8⅝c., and most of the lead went out on contract at 8¾c. Of course, under these circumstances there is some buying in the St. Louis market for shipment to the East. The only large order of the week was one of 1,000 tons placed by a prominent electrical company, at a figure below the Smelting company's price. Sellers

of lead are encouraged today by the advance in future lead in London.

Sales of Zinc Heavy but at Lower Prices

Prime Western zinc was bought in large tonnages by galvanizers during the week. Sales reported totaled about 4,000 tons. The acute fall in price of the metal in London made it necessary to give substantial concessions to consumers, however, so that the price of Prime Western gradually dropped from 7.35 to 7c. per lb. East St. Louis. Today there is a little more confidence in the market, but only a slightly increased price. The month of delivery has played no part in making quotations, owing to the sharp price fluctuations. High-grade zinc is unchanged at 8¼ to 8¾c. per lb.

Tin Off 1c. in Week

Tin prices have shared in the general decline without attracting much buying on the part of consumers. One of the leading interests here has been decidedly bearish, and prices have often been below London parity. March deliveries were classified as follows

	March, 1925	Three Months, 1925
Straits	7,040	20,235
Chinese	745	1,705
English	540	1,625
Australian	.....	125
Banka and Billiton	.....	100
Sundries	10	10
Total, long tons.	8,335	23,800

Silver Prices Sagging

Silver improved slightly on the strength of some buying for China account, probably a covering operation against previous sales. The reversal of China's position, however, was short lived, and with India showing no interest in the market, prices quickly sagged again, and new low quotations for the year were reached in both London and New York on April 1st. These low rates coincided wth a holiday in India, and other silver markets are lifeless.

Mexican Dollars: March 26th, 27th, 28th, and 30th, 51⅞c.; 31st, 51⅝c.; April 1st, 51½c.

Foreign Money Unchanged

The principal foreign exchanges show little variation from rates quoted a week ago. On Tuesday, March 31, closing cable quotations on francs were 5.265c.; lire, 4.125c.; and marks, 23.81c. Canadian dollars, ⅛ per cent discount.

Iron and Steel Quiet

Pittsburgh, March 31, 1925

The steel market has been growing quiet, and there is now very little buying. No decrease in consumption is observable, but rather an increase in certain seasonal lines. The decrease in buying and specifying is due chiefly to the technical position of the market. Steel production has been heavy, and in excess of consumption.

Sheet prices are down to the minimum of last year. Bars, shapes, and plates are approximately at the level of Jan. 1, having lost advances recently attempted, while they are slightly above their last year's minimums.

Pig Iron.—The market has been extremely quiet. Prices are not quotably changed, at $22 for bessemer and $21 for basic and foundry, f.o.b. Valley furnaces, but interesting inquiries might bring out concessions.

Connellsville Coke.—Market dull and unchanged at $3.25 for spot or contract furnace coke and $4@$4.50 for spot foundry.

Further Decline in Zinc Blende and Lead Ore Prices

Joplin, Mo., March 28, 1925

Zinc Blende	Per Ton
High	$56.90
Premium, basis 60 per cent zinc	$54.00@$55.00
Prime Western, 60 per cent zinc	$52.00
Fines and slimes	$50.00@$48.00
Average settling price, all	$53.12

Lead Ore	
High	$139.40
Basis 80 per cent lead	$107.50
Average settling price, all	$115.43

Shipments for the week: Blende, 16,937; lead, 2,440 tons. Value, all ores the week, $1,181,190.

Shipment three months: Blende, 206,070; calamine, 509; lead, 34,959 tons. Value, all ores three months, $15,568,370—more than $1,000,000 per week.

Only one settlement for lead was reported on the $140 basis, being contracted nearly two months ago, with delivery delayed. The larger number of settlements were made on $115 basis, current two weeks ago.

Stocks of zinc ore were reduced 1,720 tons during March, but there is a gain of 5,600 tons this year. Of the visible stock of approximately 30,000 tons, two-thirds is contracted for delivery.

Platteville, Wis., March 28, 1925

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$54.00

Lead Ore	
Lead, basis 80 per cent lead	$112.00

Shipments for the week: Blende, 626 tons; lead, 66 tons. Shipments for the year: Blende, 8,760; lead, 512 tons. Shipments for the week to separating plants, 1,162 tons blende.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £125 long ton.

Antimony—Per lb.:
Chinese brands, nominal, 14@14¼c.
Cookson's "C" grade, 17@17½c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½@13c.

White oxide, Chinese, 99 per cent Sb_2O_3, 16@16½c.

Bismuth—$1.95 per lb. in ton lots. London, 7s. 6d.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Cadmium — 60c. per lb. London, 2s. 3d.@2s. 4d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 8s. for black oxide.

[1]**Germanium Oxide**—25 to 50 gm. lots, $7.50 per gm.

Iridium—$375 per oz. Nominal.

[1]**Lithium**—95@96 per cent grade in 1 to 5 lb. lots, $75 per lb.

Magnesium—Sticks, 1⅜ in., 99.9 per cent, 90c.@$1 per lb. London quotes 4s. for 99 per cent ingots or sticks.

[1]**Molybdenum**—99 per cent, $25 per kg.

Monel Metal—32c. per lb.

Nickel—Ingot 31c.; shot, 32c.; electrolytic, 38c. (99.75 per cent grade). London, £170 per long ton.

Osmiridium—Crude, $58.50 per oz.

Osmium—$100@$104 per oz.

Palladium—$79@$83 per oz. Crude, $60 per oz. London, £17½.

Platinum—Refined, $117 per oz. Crude, $115.
London, £24½ per oz. for refined.

Quicksilver—Per 75-lb. flask, $82.50. San Francisco wires $81. Quiet. London £14.

Radium—$70 per mg. radium content.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.20 per lb.

[1]**Tantalum**—Metal sheets, $275 per lb.

Tellurium—$2 per lb.

[1]**Thallium Metal—Ingot, 99 per cent pure, $5 per lb. in 25-lb. lots.**

Tungsten Metal—Powder, 97 to 98 per cent, $1 per lb. contained tungsten.
More active interest in market. Prices have advanced.

[1]**Zirconium Metal—98 per cent grade. per lb., $30.**

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:
Indian, $20.
Rhodesian, $22.
New Caledonian, $24.
Market nominal.

[1]**Galena Radio Crystals**—Best quality (50 per cent of sized fragments good) 50c. per lb. in 500-lb. lots, f.o.b. Philadelphia.

Iron Ore—Prices for iron ore and magnetite for 1924 season were published Aug. 9.

Manganese Ore—42c. per long ton unit, seaport, plus duty. Market steady. Chemical grades[1], powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian, and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—60@70c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Tantalum Ore—Foreign, 30@50c. per lb. of Ta_2O_5 contained, c.i.f. New York, according to quality.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $10.50@$11.
High-grade scheelite, $11@$11.50.

Vanadium — Minimum 18 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos:
Crude No. 1—$350@$450.
Crude No. 2—$250@$300.
Spinning fibers—$115@$200.
Magnesia and compressed sheet fibers—$65@$115.
Shingle stock—$50@$70.
Paper stock—$35@$40.
Cement stock—$15@$25.
Floats—$9@$12.
Sand—$6@$8.

All per short ton, f.o.b. mine, Quebec, tax and bags included.

No. 1 Rhodesian crude, $280; No. 2, $200@$225 per short ton, c.i.f. New York.

Better feeling in the market. Demand is increasing slowly and prices have risen in nearly all grades. Sales have been good for most producers in Canada.

Barytes—f.o.b. Kings Creek, S. C.:
Crude, $7@$8 per gross ton.
Ground, off color, $14 per ton.
White, bleached, $17 per ton.
Waterground, 300 mesh, bags included, $22 per ton, Charlotte, N. C.
Crude, $8, f.o.b. Ga.
Crude, $8.50, f.o.b. Mo.
Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.

In Canada, 94@96 per cent $BaSO_4$, $9 per net ton, f.o.b. mine.

Foreign ore being imported. Demand is fair.

Bauxite — American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.50.
Pulverized and dried, $14.
Calcined, crushed, $19@$20.
Foreign, per metric ton, c.i.f.:
French red, 5 per cent SiO_2, $5@$7.
Adriatic, low SiO_2, $4@$6.50.

Beryl—$65@$80 per ton, hand-sorted crystals, f.o.b. Vermont. Nominal.

Borax—Granulated or powdered, in bags, 4¾c. per lb., delivered. Crystals, 5c. Market normal.

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $40 per ton in carload lots.

Chalk—F.o.b. New York, per lb.:
English, extra light, 5c.
Domestic, light, 4¼@4½c.
Domestic, heavy, 3½@3¾c.
In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:
Crude No. 1, $7.
Crude No. 2, $5.50.
Washed, $8.
Powdered, $10@$20.
Powdered (Blue Ridge), $12@$15.
Imported English, f.o.b. American ports:
Lump, $12@$20.
Powdered, $45@$50.
1A grades, domestic, $16@$17, f.o.b. mines. Market slow.

Corundum — South African, $65 per ton, New York.

Diatomaceous Earth—Per short ton, f.o.b. plant, California:
Kiln-fired brick, $65.
Kiln-fired aggregate, ¼ in., $45.
Insulating powder, $30.
Natural aggregate, ¼ in., $20.
Air-floated powder, $40.
In *New England*, per ton:
Pulverized, $65.
Air float, $75.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 3½c.
Market continues good.

Feldspar—Per long ton, f.o.b. cars, *North Carolina:*
No. 1 pottery grade, $5.75@$6.50, depending upon quality.
No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $6.75@$7.25.

In *Connecticut*, per net ton, f.o.b. mines:
40 to 200 mesh, $16@$30.

In *New Hampshire*, per net ton, f.o.b. mines:
No. 1, not over 10 per cent SiO_2, $8.
No. 2 pottery grade, $7.
Ground, $17@$20, f.o.b. mill.
Market good.

In *New York*, per ton, f.o.b. cars:
No. 1 crude, $8.

In *Maine:*
No. 1, ground, $19.

In *Tennessee:*
Pottery grades, $16@$21.
Tile grades, $14@$16.
Enameling grades, $11@$16.
Crude, $7 for ordinary grades. As high as $7.25 offered for exceptional quality.
Market fair.

No. 1 Porcelain grade (Virginia) 140 mesh, $23; No. 1 Body spar (Maryland) 120 mesh, $17; Enamelers' grade (Maryland) 80-100 mesh, $15; Enamelers' grade (Virginia) 120 mesh, $22; Glassmakers' grade (Virginia) 30-100 mesh, $19; Glassmakers' grade (Maryland) 30-100 mesh, $13@$15.

Market good. March was best month since September, 1920.

In *Canada*, f.o.b. mine:
Crude, No. 1, over 12½ per cent potash, less than 5 per cent SiO_2, $7.25 @$7.50 per net ton.
Crude, No. 2, 20 to 25 per cent SiO_2, $5@$5.50 per net ton.
Ground, No. 1, 180 mesh, $20 per net ton, bags included.
Ground, No. 2, 180 mesh, $15 per net ton, bags included.

Fluorspar — F.o.b. Middle Western mines, per net ton:
Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $19@$21.
Lump, No. 2, not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $22.50.
Lump, No. 1, 95@98 per cent CaF_2, not over 2½ per cent SiO_2, $30.
Ground, 95 to 98 per Cent CaF_2 and not over 2½ per cent SiO_2, $32.50@$35 in bulk, $40 in bags or barrels.
Acid, ground, not less than 98 per cent CaF_2 and not over 1 per cent SiO_2, $45 in bulk, $50 in packages.
Market fair.

In Canada, 84@86 per cent CaF_2, less than 5 per cent silica, $18 per net ton, f.o.b. mine.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.
Powdered, imported, duty paid, $23 @$25 per ton.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Canadian, $70@$80, f.o.b. mines.

Gilsonite—Per ton, f.o.b. Colorado:
Jet asphaltum, $36.
Selects, $33.
Seconds (ordinary grades), $25.50.

Graphite—First quality, per lb.:
Ceylon lump, 7½@8½c.
Ceylon chip, 6½@7½c.
Ceylon dust, 3@5½c.
Crude amorphous, $15@$35 per ton.
Flake, No. 1 and No. 2 from New York, 12@30c.
Manufactured grades:
Flake, 12@30c. per lb.
Extra fine ground, 12@30c.
Medium fine ground, 5@14c.
Facings, 5@8c.
Amorphous, 5@18c. per lb.
Prices considerably higher than last year. Stocks in foreign market are much depleted. Prices likely to continue higher than last year.

Gypsum—Per ton, depending upon source:
Crushed rock, $2.75@$3.
Ground, $4@$6.
Agricultural, $6@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $60 per short ton, Florida mines.

Iron Oxide (See Ocher) — Ground, 95 per cent through 200 mesh, Standard Spanish red, $40 per ton.

Kaolin—See China Clay.

Lepidolite—$20@$30 per ton for ordinary grades. Nominal.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $42.50.
Dead burned, $29@$31, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 6c. per lb.
Grade "AC," 7c. per lb.
Grade "AA," fine, 8c. per lb.
Grade "C," fine and lump, 9c.
Grade "C," lump, 12c.

Mica—
North Carolina prices:
Scrap, $17@$20 per net ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1¼ in., 7c.

1½ x 2 in., 16c.	3 x 4 in., $1.75.
2 x 2 in., 30c.	3 x 5 in., $2.35.
2 x 3 in., 75c.	4 x 6 in., $3.
3 x 3 in., $1.25.	6 x 8 in., $4.5[illegible]

[1]Price furnished by Foote Mineral Co., Philadelphia.

Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.
Ground, 140 mesh, $125.
Dry ground, roofing, $30.
Dry ground, 80 mesh, $35.
Dry ground, 100 mesh, $67.50.
Dry ground, 160 mesh, $70.00.
Roofing grade, 20 mesh, $35.
Roofing grade, 100 mesh, $70.
Market continues good.

In *New Hampshire:*
Washer and disk, $320 per ton.
Scrap, $24 per ton.

White, dry ground, f.o.b. New England mill:
20 mesh, $30 per ton.
40 mesh, $50.
60 mesh, $65.
100 mesh, $80.
200 mesh, $90.

Madagascar, amber, dark, free from iron, per lb., f.o.b. New York:

No. 1	$1.80	No. 4	$0.50
No. 2	1.30	No. 5	.20
No. 3	.85	No. 6	.15

Miners at Madagascar have revised their grading in relation to that of India one grade lower. Therefore, prices have dropped sharply.

[1]**Monazite**—Minimum 6 per cent ThO_2, $120 per ton.

Ocher—"Yellow Peruvian," $25@$30 per ton, Georgia mines. Market good.

Ozocerite—Per lb. in bags, New York:
Black, 160 deg. melting point, 24@25c.
Green, 170 deg. melting point, 26@30c.

Phosphate — Per long ton, f.o.b., *Florida* export prices:
76@77 per cent, pebble, $5.75.
75 per cent, $5.25.
74@75 per cent, $5.
70 per cent, $3.50.
68 per cent, $3.10.
Market fair.

In *Tennessee*, per long ton:
78 per cent lump, $8.
75 per cent hand-mined lump, $6.75@$7.
75 per cent washed lump, $7.
72 per cent washed run of mine, $5@$5.50.
65 per cent ground 95 per cent through 100 mesh, $7 per short ton.

Potash—	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent	$34.55	$33.30
Sulphate of potash 90@95 per cent, basis 90 per cent	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent	19.03	17.33
Manure salt 20 per cent	12.55	10.55
Kainit 14 per cent	10.25	8.25
Kainit 12.4 per cent	9.75	7.75

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

For prompt shipment:
5 per cent on minimum quantity of 50 short tons K_2O
6 per cent on minimum quantity of 100 short tons K_2O
7 per cent on minimum quantity of 300 short tons K_2O
10 per cent on minimum quantity of 500 short tons K_2O

The calculations are on total quantity of foreign potash salts imported during the present fertilizer year ending on April 30, 1925.

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 12c.
Lump, 11c.
Fines, through ½ in., 11½c.
Cinder from ore to remain property of buyers.

Quartz Rock Crystals — Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 30c. per lb. in ton lots.
For optical purposes, double above prices.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, $200 per ton, Florida.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
400 mesh, $31.
325 mesh, $26.
250 mesh, $22.
200 mesh, $20.
100 mesh, $8.
Other grades per ton:
140 mesh, $6.25.
200 mesh, $8.75.
Packed in bags, f.o.b. Ottawa, Ill.

Quartzite, in Canada, 99 per cent SiO_2, $3 net ton.

Glass sand, $2@$2.25 per ton; brick and molding sand, $2@$2.25. Dull.

Spodumene — $20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—Per ton, in 50-lb. paper bags, *Vermont* mills, carloads:
Ground, 200 mesh, extra white, $11, bags extra.
Ground, 180 mesh, medium white, $10, bags extra.
Ground, 160 mesh, medium white, $10@$11.
Demand has been less active in March.

In *New York*, double air-floated, including containers, per net ton:
200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand good.

In *California*, $20@$30 per ton, ground.

In *Georgia*, powdered, per ton:
Gray or yellow, $7.50@$10.
Red or white, $10@$14.
Market good for powders.
White, $12@$15.
Grayish white, $8@$10.
Red, $12@$14.
Yellow, $8@$12.
Roofing, $7.50@$8.
Market good.

Tripoli—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:
Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.
Double ground:
Rose and cream, $17@$25.
White, $19@$30.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Air-float:
Rose and cream, $25@$30.
White, $35.
Fair spring business.

Zircon—Freight allowed east of Mississippi River:
99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

Mineral Products

Arsenious Oxide (white arsenic)—5½@5¾c. per lb. delivered.

Copper Sulphate—4.65c. per lb.

Sodium Nitrate—$2.66 per 100 lb., ex vessel Atlantic ports.

Sodium Sulphate—$19@$22 per ton, New York.

Zinc Oxide—Per lb. in bags:
Lead free, 7¾c.
5 per cent lead sulphate, 6¾c.
10 to 35 per cent lead sulphate, 6½c.
French, red seal, 9¾c.
French, green seal, 10¾c.
French, white seal, 12c.

Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 23c. per lb.; 4 to 6 per cent carbon, 11½c. per lb.

Ferromanganese—Domestic and foreign, 78@82 per cent, $115 per gross ton. Spiegeleisen, 19@21 per cent, $33 f.o.b. furnace; 16@19 per cent, $32.

Ferromolybdenum—$1.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $39.50@$44.50 per gross ton, f.o.b. works; 50 per cent, $85 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — $1 per lb. of contained W, f.o.b. works. Nominal.

[1]**Ferro-uranium**—30 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.25@$3.75 per lb. of V contained, f.o.b. works. Market very active.

Metal Products

Rolled Copper—Sheets, 21¾c.; wire, 15¾c.

Lead Sheets—Full lead sheets, 12c. per lb.; cut lead sheets, 12¼c. in quantity, mill lots.

Nickel Silver—28¼c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 19¾c. per lb.; rods, 16¼c. per lb.

Zinc Sheets — 10¼c. per lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$48@$50 per net ton, f.o.b. shipping point.

Firebrick—First quality, $43@$46 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $36@$40.

Magnesite — Brick, 9-in. straights, $65@$68 per net ton, f.o.b. works. Dead-burned grain magnesite, $40@$42 per net ton, Chester, Pa.; $29@$31, Chewelah, Wash.

Silica Brick—$40@$42 per M. Pennsylvania; $45@$47 Alabama; $49@$51, Indiana.

[1]**Zirkite**—Powdered, 80 per cent ZrO_2, 3c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 80c.@$1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1924	1925	1924	1925	1924	1925
January	63.447	68.447	33.549	32.197	425.524	477.702
February	64.359	68.472	33.565	32.245	430.457	476.886
March	63.957	67.808	33.483	31.935	428.769	477.279
April	64.139	.....	33.065	.....	434.788	.....
May	65.524	.....	33.870	.....	435.716	.....
June	66.690	.....	34.758	.....	431.675	.....
July	67.159	.....	34.509	.....	436.649	.....
August	68.519	.....	34.213	.....	449.510	.....
September	69.350	.....	34.832	.....	445.740	.....
October	70.827	.....	35.387	.....	448.274	.....
November	69.299	.....	33.775	.....	460.543	.....
December	68.096	.....	32.620	.....	469.115	.....
Year	66.781	.....	33.969	.....	441.397	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1924	1925	1924	1925	1924	1925
January	12.401	14.709	61.273	66.065	67.193	70.607
February	12.708	14.463	63.113	64.713	68.167	69.525
March	13.515	14.004	66.137	62.892	72.087	67.739
April	13.206	.....	64.338	.....	70.150	.....
May	12.772	.....	62.006	.....	67.648	.....
June	12.327	.....	61.375	.....	66.313	.....
July	12.390	.....	61.652	.....	65.815	.....
August	13.221	.....	63.481	.....	67.800	.....
September	12.917	.....	62.750	.....	67.125	.....
October	12.933	.....	62.641	.....	66.620	.....
November	13.635	.....	63.731	.....	68.063	.....
December	14.260	.....	65.295	.....	69.762	.....
Year	13.024	.....	63.149	.....	68.062	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1924	1925	1924	1925	1924	1925
January	7.972	10.169	8.002	9.953	31.528	41.443
February	8.554	9.428	8.643	9.126	34.589	37.944
March	9.013	8.914	8.891	8.578	37.161	36.804
April	8.263	.....	7.932	.....	32.819	.....
May	7.269	.....	6.973	.....	29.426	.....
June	7.020	.....	6.848	.....	32.138	.....
July	7.117	.....	6.886	.....	32.916	.....
August	7.827	.....	7.764	.....	32.728	.....
September	8.00	.....	7.876	.....	33.023	.....
October	8.235	.....	8.118	.....	35.715	.....
November	8.689	.....	8.590	.....	39.425	.....
December	9.207	.....	9.106	.....	41.583	.....
	8.097	.....	7.969	.....	34.421	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1924	1925	1924	1925	1924	1925
January	48.250	57.692	48.750	58.250	246.790	265.560
February	52.772	56.517	53.272	57.068	272.399	262.181
March	54.370	53.038	54.870	53.733	277.429	245.682
April	49.457	.....	49.957	.....	250.863	.....
May	43.611	.....	44.111	.....	218.511	.....
June	42.265	.....	42.765	.....	219.219	.....
July	45.750	.....	46.250	.....	233.332	.....
August	51.409	.....	51.909	.....	254.638	.....
September	48.595	.....	49.095	.....	243.511	.....
October	50.038	.....	50.538	.....	248.543	.....
November	53.848	.....	54.348	.....	257.738	.....
December	55.721	.....	56.245	.....	261.875	.....
Year	49.674	.....	50.176	.....	248.737	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1924	1925	1924	1925
January	6.426	7.738	34.761	37.917
February	6.756	7.480	36.518	36.528
March	6.488	7.319	35.298	35.741
April	6.121	.....	32.588	.....
May	5.793	.....	30.648	.....
June	5.792	.....	31.788	.....
July	5.898	.....	32.193	.....
August	6.175	.....	32.544	.....
September	6.181	.....	32.926	.....
October	6.324	.....	33.514	.....
November	6.796	.....	35.022	.....
December	7.374	.....	36.932	.....
Year	6.344	.....	33.728	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude
	1924	1925	1924	1925	1924	1925	1925
January	10.279	17.428	59.500	81.596	122.115	117.00	111.663
February	10.935	19.795	59.565	79.386	124.739	117.00	114.216
March	11.442	15.553	64.269	80.481	121.692	117.00	115.00
April	9.952	.....	74.308	.....	115.577	.....	.....
May	8.755	.....	76.962	.....	115.731	.....	.....
June	8.403	.....	73.720	.....	116.000	.....	.....
July	8.477	.....	72.173	.....	118.231	.....	.....
August	9.839	.....	72.096	.....	120.000	.....	.....
September	11.022	.....	72.423	.....	118.923	.....	.....
October	11.519	.....	70.654	.....	118.000	.....	.....
November	14.385	.....	68.708	.....	117.792	.....	.....
December	15.024	.....	72.750	.....	117.000	.....	.....
Year	10.836	.....	69.761	.....	118.817	.....	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1924	1925	1924	1925	1924	1925
January	24.76	24.66	23.76	23.76	23.88	23.76
February	25.26	24.50	23.76	23.26	25.06	23.76
March	25.14	.....	23.76	.....	24.76	.....
April	24.56	.....	23.26	.....	23.80	.....
May	23.89	.....	22.08	.....	22.91	.....
June	22.90	.....	21.49	.....	21.48	.....
July	21.90	.....	20.76	.....	20.76	.....
August	21.76	.....	20.76	.....	20.99	.....
September	21.76	.....	20.76	.....	21.68	.....
October	21.76	.....	20.26	.....	21.26	.....
November	22.08	.....	21.44	.....	21.17	.....
December	23.65	.....	22.04	.....	22.86	.....
Year	23.28	.....	22.01	.....	22.55	.....

In dollars per long ton.

Monthly Crude Copper Production

	1924		1925	
	November	December	January	February
Domestic				
Alaska shipments	8,902,042	6,633,986	2,565,375	6,855,097
Calumet & Arizona	4,028,000	3,650,000	3,788,000	3,068,000
Miami	4,732,000	4,699,547	4,800,000	4,317,000
New Cornelia	5,703,506	6,713,520	6,906,512	6,063,428
Old Dominion	2,937,000	2,956,000	2,921,000	3,377,000
Phelps Dodge	12,260,000	12,242,000	13,544	16,554,000
United Verde Extension	3,136,660	3,687,440	3,739,542	3,631,638
A.S. & R. & Tenn. Copper	11,750,000	15,500,000	16,700,000	12,500,000
Imports: Ore and concentrates, matte	19,703,976	15,080,051	11,229,750	16,662,339
Partly from				
Chile	.....	.....	1,309,814	3,463,647
Cuba	.....	.....	.....	2,625,886
Canada	.....	.....	4,942,710	5,016,488
Mexico	.....	.....	3,519,950	2,255,980
Imports of black and blister, unrefined	48,686,075	37,707,825	15,858,870	35,002,977
Partly from				
Chile	.....	.....	3,934,732	6,518,562
Peru	.....	.....	3,282,903	6,261,118
Africa	.....	.....	.....	2,464,764
Mexico	.....	.....	3,681,048	8,772,922
Imports of refined and old	17,030,588	9,905,642	5,652,229	8,561,246
Foreign				
Boleo, Mexico	1,553,320	1,551,769	1,530,270	1,389,150
Falcon Mines, Rhodesia	419,400	425,200	420,000	.....
Furukawa, Japan	2,446,745	2,399,650	2,476,376	.....
Cons. M & S., Canada	.....	.....	.....	.....
Granby Cons., Canada	3,006,550	2,776,365	3,282,570	2,761,468
Katanga, Africa	17,386,152	17,221,050	15,866,025	12,857,510
Mount Morgan, Aust.	498,000	544,000	298,000	202,000
Mount Lyell, Aust.	1,036,000	1,036,000	.....	.....
Phelps Dodge, Mexican	3,712,000	3,226,000	3,134,000	3,518,000
Sumitomo, Japan	2,911,254	2,274,146	2,136,864	.....

Comparative U. S. Copper Mine Production

	1922	1923	1924	1925
January	32,010,292	112,267,000	133,356,000	148,716,000
February	45,957,530	102,725,000	128,260,000	138,772,000
March	55,705,760	121,562,000	129,816,000	.....
April	76,601,000	118,157,000	131,928,000	.....
May	88,714,000	125,438,000	130,644,000	.....
June	93,740,000	125,479,000	127,506,000	.....
July	91,000,000	125,249,000	129,574,000	.....
August	101,188,000	131,088,000	133,512,000	.....
September	96,408,000	124,523,000	126,346,000	.....
October	103,273,000	132,481,000	137,924,000	.....
November	102,845,000	127,963,000	136,582,000	.....
December	103,003,000	129,354,000	135,294,000	.....

Company Reports

The American Metal Co., Ltd.

A report of The American Metal Co., Ltd., for 1924 states that the management continues active in the exploration of new mining properties and the enlargement of its plant facilities. Among the more important construction work under way is the expansion of the company's refining capacity and the erection of a modern smelter at its works at Carteret, N. J., which are approaching completion.

After paying a 7 per cent dividend, amounting to $350,000, upon the company's preferred stock of 50,000 shares, the net earnings on the common stock of 591,593 shares were $5 per share for the year. A dividend of $3 per share on the common stock was paid during the year.

Consolidated Balance Sheet, Dec. 31, 1924

Assets		
Current		$25,860,988.71
Fixed		19,960,265.75
		$45,821,254.46
Liabilities		
Total current liabilities		$7,511,355.24
First-mortgage sinking fund bonds		341,000.00
Contingent reserves		3,591,680.03
Capital		
Capital stock	$25,112,273.52	
Surplus as per appended statement	9,264,945.67	
		34,377,219.10
		$45,821,254.46

Consolidated Surplus Account For 1924

Surplus at beginning of year		$8,152,174.70
Income from operations during year after deducting management's share of profits	$5,317,994.78	
Less depreciation, depletion and expenses	$1,285,167.89	
Special provisions for reduction of inventories	721,781.38	
	2,006,949.27	
Net income	$3,311,045.51	
Surplus of subsidiaries transferred to ordinary reserves	187,428.58	
Additions to consolidated surplus through acquisitions of stocks of subsidiaries	112,549.29	
	$3,236,166.22	
Less dividends		
Preferred, $7 per share on 50,000 shares	$350,000.00	
Common, no par value stock, at the rate of $3 per annum on 590,790 shares	1,773,395.25	
	2,123,395.25	
Balance added to surplus		1,112,770.97
Surplus at Dec. 31, 1924		$9,264,945.67

Bethlehem Steel Corporation

The Bethlehem Steel Corporation in its annual statement for 1924 reports shipments and deliveries by subsidiary companies of $243,904,265. This compares with shipments and deliveries to the value of $275,213,422 for the preceding year. Net income for the year, after providing $11,846,891 for depreciation and depletion, was $8,916,181, a decrease of $5,457,971 over that of 1923. After providing for preferred dividends the net income for the year was equivalent to $2.56 per share on the common stock outstanding.

After providing for dividends of $6,548,154, including $2,247,571 on the common stock, there was a surplus of $2,368,027, compared with a surplus of $2,288,825 for 1923.

The consolidated balance sheet as of Dec. 31, 1924, shows current assets of $167,229,945 against current liabilities of $30,068,158.

Orders on hand at the end of 1924 were $77,049,619, compared to $53,264,911 at the end of 1923.

The report shows for the first time the tonnage production of the company for raw materials, pig iron, steel ingots, and finished products. The production shown is:

	1924 Gross Tons	1923 Gross Tons
Ore	4,753,889	5,466,799
Limestone	1,361,345	1,190,978
Coal	5,586,200	6,593,668
Coke	3,446,728	4,261,976
Pig iron and ferromanganese	3,435,011	4,033,015
Steel ingots	4,419,037	4,761,254
Rolled steel and other finished products for sale	3,266,245	3,541,713

United States Steel Corporation

A report of the operations of the United States Steel Corporation for 1924 shows a net income of $153,114,812, compared with $179,646,674 for 1923, as follows:

Comparative Income Account

	1924	1923
Earnings before charging interest on bonds and mortgages of subsidiary companies	(a)$161,183,467.99	(a)$187,953,667.85
Less interest on bonds of subsidiary companies	8,068,656.07	8,306,993.48
Balance of earnings	$153,114,811.92	$179,646,674.37
Less depreciation and replacement reserves and sinking funds on bonds of subsidiary companies	38,687,668.14	41,745,434.23
Sinking funds on U. S. Steel Corporation bonds	10,205,168.92	9,724,720.38
Net income in the year	$104,221,974.86	$128,176,519.76
Deduct		
Interest on U. S. Steel Corporation bonds outstanding	18,274,207.49	18,764,567.62
Premium on bonds redeemed and acquired for sinking fund, viz.:		
On subsidiary companies' bonds	182,350.09	165,611.86
On U. S. Steel Corporation bonds	785,295.44	774,464.84
Balance	$84,980,121.84	$108,471,875.44
Add net balance of sundry receipts and charges	87,069.77	235,188.82
	$85,067,191.61	$108,707,064.26
Dividends on U. S. Steel Corporation stocks, viz.:		
Preferred, 7 per cent	25,219,677.00	25,219,677.00
Common { 1924, regular 5 per cent, extra 2 per cent / 1923, regular 5 per cent, extra 1 per cent }	35,175,175.00	29,227,393.75
Surplus net income	$24,266,339.61	$54,259,993.51
Less sums appropriated and expended or to be expended on account of additions, improvements, or betterments	20,000,000.00	40,000,000.00
Balance carried forward to undivided surplus	$4,266,339.61	$14,259,993.51

(a) Balance of earnings after making allowances for estimated amount of federal income taxes.

Production Record

Products	1924	1923
Ores mined	Tons	Tons
Missabe and Vermilion ranges (iron ore)	17,864,794	24,658,317
Gogebic, Menominee, and Marquette ranges	3,167,716	3,005,181
In Alabama (iron ore)	3,690,262	3,239,370
In Brazil (manganese ore)	51,769	112,241
Total	24,774,541	31,015,109
Limestone quarried (Includes dolomite and fluorspar)	5,033,889	6,575,694
Coal mined		
For use in the manufacture of coke	21,041,573	28,234,030
For steam, gas and all other purposes	6,696,434	7,055,871
Total	27,738,007	35,289,901
Pig iron	12,520,329	16,527,830
Spiegel, ferromanganese, and ferrosilicon	163,400	201,396
Total	12,683,729	16,729,226
Bessemer ingots	3,856,559	5,451,390
Open-hearth ingots	12,622,298	14,878,560
Total	16,478,857	20,329,950
	Bbl.	Bbl.
Universal portland cement	15,156,000	14,440,000

Bingham Mines Co.

Silver-Lead; Utah

Bingham Mines' report for 1924 shows a net operating gain for the year of $261,507.07, after deducting $91,048.38 for prospecting and development, but before making deductions for depreciation and depletion. Of the earnings, $187,000 was made during the last four months, which was due largely to the splendid showing of the Victoria mine.

At the Dalton & Lark, the earnings also improved in the last months of the year, and the prospects at this property are more encouraging than they have been for some time.

A dividend of 50c. per share was declared payable on Jan. 2, 1925, to stockholders of record Dec. 20, 1924.

On Dec. 31st, the outstanding stock of this company was 65,000 shares, the company having purchased during the year 6,297 shares at a total cost of $122,925, or at an average price of $19.52 per share.

No dividends have been received this year from the Eagle & Blue Bell Mining Co.

Consolidated Balance Sheet as of Dec. 31, 1924

Assets

Mining property and real estate	$2,592,167.82
Mine construction and equipment	207,576.57
Office furniture and fixtures	1,480.17
Mining stocks	115,582.30
Bingham Mines Co. stock (purhase of 85,000 shares)	1,095,218.90
Prepaid insurance and other expenses	4,357.18
Supplies at mines	24,180.91
Accounts receivable	120,476.33
Notes receivable	293,969.81
Cash	286,626.60
	$4,741,636.59

Liabilities

Capital stock	$1,500,000.00
Surplus	1,801,363.80
Minority interest	38,490.13
Accounts payable (including federal taxes)	44,490.13
Accounts payable (No. 11—Jan. 2, 1925)	32,500.00
Depreciation	229,637.69
Depletion and amortization	1,094,774.53
	$4,741,636.59

Consolidated Operating Statement for the Year Ended Dec. 31, 1924

Gross earnings	$1,105,374.49
Expenses	732,224.14
Net earnings and revenues	$382,150.35
Prospecting and development	110,146.50
Net operating gain	$272,003.85
Less—Outside interests	302.31
Bingham Mines Co. net gain and equity	$271,701.54

Superior and Boston Copper Co.

Copper; Globe, Ariz.

Copper production from the Superior and Boston Copper Co. during the fiscal year ended Sept. 30, 1924, amounted to 1,560,599 lb., a decrease of approximately 150,000 lb. compared with the previous year's production.

The output of silver increased from 205,659 oz. in the previous year to 297,066 oz., an increase of over 91,400 oz.

Receipts and Disbursements for Year Ended Sept. 30, 1924

Receipts	
Ore sales	$261,087.55
Interest on deposits	1,114.63
Account call No. 11 collected	98,933.00
	$361,135.18
Mine disbursements	$310,024.87
General expenses	21,317.96
	$331,342.83

Profit-and-Loss Account

Balance, Sept. 30, 1923	$62,191.74	
Interest on deposits	1,114.63	
Balance, Sept. 30, 1924		$63,306.37

Imports and Exports of Ores and Metals in February, 1924 and 1925

Imports and exports of certain metals and ores during February, 1925, with revised comparative figures for February, 1924, as compiled by the U. S. Department of Commerce, are as follows:

In Pounds, Unless Otherwise Stated

	February, 1924	February, 1925
Antimony		
Ore	363,042	24,000
Liquated, regulus, or metal	2,850,874	1,156,904
Copper		
Ores	13,857,422	11,710,635
Concentrates	3,460,460	4,951,704
Total	17,317,882	16,662,339
From		
Spain	2,574,747	1,439,715
Canada	5,824,253	5,016,488
Mexico	2,084,880	2,255,980
Cuba	1,776,580	2,625,886
Chile	4,795,426	3,463,647
Peru	14,100	38,577
Other countries	247,896	1,822,041
Unrefined, black, blister, and converted copper in pigs, bars, and other forms	43,585,621	35,002,977
From		
Spain	1,413,782	615,250
United Kingdom	531,186	.....
Canada	8,837,891	4,549,952
Mexico	5,708,783	8,772,922
Chile	9,862,621	6,518,562
Peru	5,073,385	6,261,118
Portuguese Africa	11,681,367	2,464,764
Other countries	476,606	5,820,409
Refined copper	7,451,701	7,104,569
Old and clippings for remanufacture	65,931	1,442,689
Composition metal, copper chief value	21,820	11,645
Copper manufactures	3,420	2,343
Brass		
Old and clippings for remanufacture	1,297,190	977,439
Manufactures of brass	43,231	62,591
Lead		
Ore and matte	5,666,070	7,699,620
Bullion or base bullion	9,943,574	11,612,384
Pigs, bars, other forms, and old	3,078,969	2,728,800
Manufactures of, except type metal	33,801	17,024
Manganese ore, long tons	4,430	9,666
Pyrites, long tons	11,250	41,831
Tin		
Tin ore, tons	7	.....
In blocks, bars, and pigs	20,599,282	13,702,848
From		
United Kingdom	3,780,166	2,084,369
British Straits Settlements	14,929,727	8,850,253
China	.....	616,083
Hongkong	739,487	897,482
Australia	277,760	147,844
Other countries	872,142	1,106,817
Zinc		
Ore Free	.....	318
Dutiable	33,506	158,231
Blocks, pigs, and other forms	2,796	4,839
Zinc dust	25	12,410

Exports of Copper, Lead and Zinc

In Pounds	February, 1924	February, 1925
Copper		
Ores, concentrates, matte, and regulus	3,051	319,746
Copper and manufactures of	91,539,991	65,242,633
Refined in ingots, bars, and other forms	.....	56,990,450
Exported to		
Belgium	5,184,729	4,959,922
France	7,723,975	9,294,987
Germany	12,726,969	9,900,054
Italy	7,165,243	5,481,694
Netherlands	1,132,514	11,949,909
Spain	481,712	246,418
Sweden	2,420,976	2,200,947
United Kingdom	25,291,842	10,748,027
Canada	1,936,170	1,867,855
British India	788,350	.....
China	12,263,200	.....
Japan	2,351,508	89,600
Other countries	353,997	251,037
Old and scrap copper	321,397	1,136,852
Pipes and tubes	161,244	90,396
Plates and sheets	1,322,799	715,243
Rods	6,925,930	4,255,721
Wire	722,317	1,013,346
Insulated copper wire and cable	2,093,379	867,404
Other manufacturers of copper	171,740	173,221
Lead		
Pigs, bars, and other forms:		
From domestic ore	996,267	1,231,881
From foreign ore	6,081,455	17,422,074
Exported to:		
France	1,792,511	1,926,962
Germany	338,042	4,873,607
Netherlands	504,131	1,568,532
United Kingdom	885,264	7,573,239
Other Europe	3,002,792	1,859,634
Argentina	.....	291,281
Brazil	488,236	280,072
Other countries	66,746	280,628
Other lead manufactures	400,563	520,196
Zinc		
Dross	.....	3,038,948
Ores and concentrates	164	.....
Zinc (spelter) in slabs, blocks, or pigs	17,125,292	17,375,215
Exported to		
Belgium	112,000	728,150
France	2,318,750	1,512,398
Germany	391,938	2,712,169
Italy	1,411,551	336,176
United Kingdom	12,198,941	7,609,426
Canada	262,602	5,558
Other countries	429,510	4,471,338
In sheets, strips, and other forms	772,241	611,841
Zinc dust	328,131	298,163
Other zinc manufactures	30,498	63,675

Transvaal Gold Production

In Fine Ounces

	1919	1920	1921	1922	1923	1924	1925
Jan.	676,059	670,503	651,593		764,469	796,768	823,692
Feb.	636,728	625,330	558,137	639,728	704,970	760,617	753,925
March	712,379	707,036	671,123		761,586	795,671	.....
April	694,944	686,979	681,382	511,338	743,651	768,923	.....
May	724,995	669,041	687,776	629,786	786,564	809,003	.....
June	702,379	715,957	678,490	675,697	755,309	773,053	.....
July	725,497	786,099	689,555	730,635	754,306	829,437	.....
August	706,669	702,083	711,526	752,490	769,371	809,571	.....
Sept.	698,558	682,173	691,026	747,089	739,504	799,422	.....
Oct.	723,722	662,472	707,825	778,159	793,842	827,583	.....
Nov.	677,970	633,737	704,236	764,476	708,639	802,313	.....
Dec.	650,791	632,215	681,847	790,712	778,849	825,273	.....
Totals	8,330,091	8,153,625	8,114,516	7,020,110	9,133,060	9,597,634	.....

Mining Stocks

Week Ended March 28, 1925

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb			*6		
Anaconda	New York	38	36½	37¼	Ap.16, My.23,	0.75
Arcadian Consol.	Boston	1⅛	1⅛	1⅛		
Ariz. Com'l.	Boston	11	9½	9⅝	Ja. 19, Ja. 31	0.50
Calaveras	N. Y. Curb			1½		
Calumet & Arizona	New York	49½	47⅜	47½	Mh.6, Mh.28 Q	0.50
Calumet & Hecla	Boston	14⅛	14	14	Ja.30, Mh.4	0.50
Canario Copper	N. Y. Curb	3⅜	3⅛	3⅜		
Cerro de Pasco	New York	47	43½	43½	Ja. 22, Fe. 2, Q	1.00
Chile Copper	New York	32⅜	31⅛	31⅛	Mh.3,Mh.20, Q	0.62½
Chino	New York	21½	21	21	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3⅛	2⅞	3		
Copper Range	Boston	23½	21¼	21¼	May, 1924	1.00
Crystal Copper	Boston Curb	*62	*57	*62		
Davis-Daly	Boston	*7	*7	*7	Mar., 1920	0.25
East Butte	Boston	4	3½	4	Dec., 1919	0.50
First National	Boston Curb	*20	*15	*15	Feb., 1919	0.15
Franklin	Boston	1	*50	*50		
Gadsden Copper	Boston Curb	*63	*50	*53		
Granby Consol.	New York	16	14½	14½	May, 1919	1.25
Greene-Cananea	New York	13⅜	13	13	Nov., 1920	0.50
Hancock	Boston			1¼		
HoweSound.new,r.t.c.	N. Y. Curb	19½	18	18	April 1924	0.05
Inspiration Consl.	New York	25	22½	23	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	2	1½	1⅝	May, 1923	0.15
Isle Royale	Boston	14⅜	13½	13⅔	Sept. 1923	0.50
Jerome Verde Dev	N. Y. Curb	1⅛	1	1⅛		
Kennecott	New York	49⅞	47½	47⅞	Mh.6, Ap.1, Q	0.75
Keweenaw	Boston	*75	*75	*75		
Lake Copper	Boston	1⅜	1⅛	1⅛		
Magma Copper	New York	37⅛	36⅞	37	Jan., 1919	0.50
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅛		
Mass Consolidated	Boston	*50	*50	*50	Nov., 1917	1.00
Miami Copper	New York	11⅞	11⅛	11⅛	Fe.2 Fe.16 Q	0.50
Mohawk	Boston	30	28½	28½	Ja. 13, Mh. 2	1.00
Mother Lode Coa.	New York	7⅛	6⅞	7	De. 12, De. 31	0.37½
Nevada Consol.	New York	13⅜	13⅛	13⅜	Sept., 1920	0.25
New Cornelia	Boston	21⅛	19⅝	19⅝	Fe. 6, Fe. 23	0.25
North Butte	Boston	1⅝	1⅝	1⅝	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*84	*76	*76	No.14, De.2	0.05
Old Dominion	Boston	20½	19	19½	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†115	†112		Mh 20, Ap.2 Q	1.00
Quincy	Boston	24½	21½	22½	Mar., 1920	1.00
Ray Consolidated	New York	13⅜	12⅛	12⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb			14		
St. Mary's Min. Ld.	Boston	35	33	34	May 1924	3.00
Seneca Copper	New York			‡		
Shannon	Boston	*70	*60	*65	Nov., 1917	0.25
Shattuck Arizona	New York	5⅜	5⅛	5⅛	Jan., 1920	0.25
Superior & Boston	Boston	1⅛	1	1		
Tenn. C. & C.	New York	8⅛	7⅛	8	De.31, Ja.15,Q	0.25
United Verde Ex.	N. Y. Curb	25	25	25	Ap. 3, Ap. 15	1.00
Utah Copper	New York	85	82⅛	83	Mh.20,Mh.31,Q	1.00
Utah Metal & T.	Boston	*65	*60	*60	Dec., 1917	0.30
Victoria	Boston			*60		
Walker Mining	Salt Lake	3.30	3.27½	3.22½		
Winona	Boston	*18	*15	*18		
NICKEL-COPPER						
Internat. Nickel	New York	26½	24⅛	26⅛	March, 1919	0.50
Internat. Nickel pfd.	New York	98	98	98	Ja. 15, Fe. 2, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	6⅛	6	6		
Gladstone M. M. Co.	Spokane	*21	*20	*21	Mh.5, Mh.10,	0.00½
National Lead	New York	150⅛	142⅜	142⅜	Mh.13,Mh.31,Q	2.00
National Lead pfd.	New York	116	116	116	Fe.2, Mh.14, Q	1.75
St. Joseph Lead	New York	48⅛	45	45	Mh. 5, Mh. 20	0.50
ZINC						
Am. Z. L. & S.	New York	8	7⅞	8	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	28	27	27	Nov., 1920	1.50
Butte C. & Z.	New York	6⅞	6	6⅛	De.10, De.24	0.50
Butte & Superior	New York	17⅜	16	16	Mh.19, Mh.31	0.50
Callahan Zn-Ld.	New York	3⅜	3	3	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	187½	183⅞	187½	Ap.20, My.9	2.00
United Zinc	N. Y. Curb			*35		
Yellow Pine	Los Angeles	*70	*65	*66	De.10,De.15 Q	0.04
SILVER						
Alvarado	Boston Curb			2	Oct. 1920	0.50
Beaver Consol.	Toronto	*33	*31½	*32½	May, 1920	0.03
Castle-Trethewey	Toronto	*80½	*79	*80		
Coniagas	Toronto			2.00	May, 1924	0.12½
Keeley	Toronto	2.08	2.02	2.07	Mh.1, Mh.15SA	0.12
Kerr Lake	N. Y. Curb	1½	1½	1½	Ap.1, Ap.15,Q	0.12½
La Rose	Toronto	*49½	*41½	*47	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.25	1.25	1.25	Ap. 15, 25	0.05
McKinley-Dar.-Sav.	Toronto	*33½	*27	*29	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.75	2.70	2.71	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6⅛	6	6⅛	Mh.31, Ap.21	0.15
Ontario Silver	New York	5⅜	5⅜	5⅜	Jan., 1919	0.50
Temiskaming	Toronto	*20	*20	*20	Jan., 1920	0.40
GOLD						
Alaska Juneau	New York	2⅛	1⅞	2⅛		
Argonaut	Toronto	*40	*33½	*39½		
Carson Hill	Boston	*55	*40	*40		
Consol. W. Dome L.	Toronto	*16⅝	*16	*16½		
Creason Consol. G.	N. Y. Curb	3⅝	3⅜	3⅜	Mh.31, Ap.10 Q	0.10
Crown Reserve	Toronto	*37½	*35	*37	Jan. 1917	0.05
Dome Mines	New York	14½	14¼	14½	Mh.31,Ap.20,Q	0.50
Golden Cycle	Colo. Springs	1.45	1.42	1.44	Dec.11, 1924	0.03
Hollinger Consol.	Toronto	14.00	13.60	13.91	Ap.6, Ap.22, M	0.05
Homestake Mining	New York	44½	44	44	Mh.20,Mh.25,M	0.50
Jib. Consol.	N.Y. Curb	*14	*7	*7		
Kirkland Lake	Toronto	*42½	*41½	*42½		
Lake Shore	Toronto	5.90	5.70	5.87	Mh.2,Mh.16,	0.05
McIntyre-Porcupine	New York	17⅛	16⅞	17⅛	Fe.2, Mh.2,	0.25
Newray	Toronto	*24	*23	*23		
Night Hawk Pen.	Toronto	*26	*20	*24		
Portland	Colo. Springs	*50	*50	*50	Oct., 1920	0.01
Rand Mines	New York			35½	Fe.17, Fe.25	1.79
Teck-Hughes	Toronto	1.45	1.38	1.44		
Tom Reed	Los Angeles	*68½	*66	*66	Dec., 1919	0.02
Tough-Oakes	Toronto	*36	*31	*33		
United Eastern	N. Y. Curb	*54	*52	*52	July, 1924	0.05
Vipond Cons.	Toronto	1.21	1.17	1.19		
Wright-Hargreaves	Toronto	4.70	4.40	4.65	Mh.16,Ap.1,QX	0.05
GOLD AND SILVER						
Black Oak	N. Y. Curb			*81		
Con. Cortez	N. Y. Curb	*13	*13	*13		
Con. Virginia	San Francisco	*9½	*7½	*7½		
Continental Mines	N. Y. Curb			1¼		
Dolores Esperanza	N. Y. Curb	*60	*50	*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅜	2⅛	2⅛	Mh.23, Ap.3,	0.08
Tonopah Belmont	N. Y. Curb	*65	*60	*60	Mh.15, Ap.1	0.05
Tonopah Divide	N. Y. Curb	*24	*24	*24	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2⅜	2⅜	2⅛	Mh.11, Ap.1, Q	0.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Fe. 12,Fe. 25,	0.50
Unity Gold	N. Y. Curb	*54	*54	*54		
West End Consol.	N. Y. Curb			*30	Mar., 1923	0.05
Yukon Gold	N. Y. Curb			*35	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	12⅞	12⅛	12⅜	Mh.16, Ap.2,X	0.25
Bingham Mines	Boston	31⅛	30⅛	30⅞	Mh.20, Mh.31	0.50
Cardiff M. & M.	Salt Lake			1.35	De.16, No.18	0.10
Chief Consol.	Salt Lake	4.00	4.00	4.00	May, 1924	0.10
Columbus Rexall	Salt Lake	*19	*17	*19	Aug., 1923	0.05
Erupcion	Boston Curb	3⅛	3	3⅛	Mh.16, Ap.2,X	0.20
Federal M. & S.	New York	16⅛	15⅞	15⅝	Fe.26, Mh.15 Q	1.75
Federal M. & S. pfd.	New York	53⅜	51⅞	52	No.25, De.15,	1.75
Florence Silver	Spokane	5.75	5.00	5.00	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	15⅛	14⅞	15	Fe.15, Mh.15	0.50
Iron Blossom Con.	Salt Lake	*35	*35	*35	Oc.25, 1924	0.01½
Iron King Mining	Salt Lake	*72	*61	*61		
Keystone Mining	Salt Lake	*70	*67	*67		
Mammoth Mining	Salt Lake	1.80	1.62½	1.67½		
Marsh Mines	N. Y. Curb			*5	June, 1921	0.02½
Park City	Salt Lake	4.90	4.90	4.90	Mh.14, Ap.1	0.15
Park Utah	Salt Lake	3.70	3.70	3.70	April, 1924	0.15
Prince Consol.	Salt Lake	*28	*26	*27		
Silver King Coal	Salt Lake	6.60	6.50	6.50	Mh.20,Ap.1, Q	0.20
Silversmith	Spokane	*28	*24	*25	Ap.1, Ap.10	0.01
Tamarack-Custer	Spokane	*79	*70	*78	Se. 22, Se. 29	0.25
Tintic Standard	Salt Lake	9.00	8.60	9.00	Mh.23, Mh.30	0.40
Utah-Apex	Boston	6⅜	6⅛	6⅜	Ap.5, Ap.15,	0.25
Western Utah Copper	N. Y. Curb	*17	*17	*17		
IRON						
Bethlehem Steel	New York	41⅛	38⅜	40⅜	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	*40	*40	*40		
Char. Iron pfd.	Detroit			*95		
Colorado Fuel & Iron	New York	36⅛	33⅛	33⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York			108⅛	De.10, De.27	2.00
Inland Steel	New York	44⅛	42	42	Fe.14, Mh.20 Q	0.625
Mesabi Iron	N. Y. Curb	3⅛	2⅞	2⅞		
Replogle Steel	New York	15⅞	13⅛	14		
Republic I. & S.	New York	49	45⅛	46⅜	May, 1921	1.50
Republic I. & S. pfd.	New York	88⅛	88	88	Mh.8, Ap.1, Q	1.75
Sloss-Sheffield S. & I.	New York	84	81⅛	83⅛	Mh.10, Mh.20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York			94⅛	Mh.20, Ap.2, Q	1.75
U. S. Steel	New York	120⅛	115	115⅝	Fe.28,Mh.30,QX	1.75
U. S. Steel pfd.	New York	123⅜	122⅛	123	Fe.1, Fe.27, Q	1.75
Virginia I. C. & C.	New York	37	37	37	De.15, Ja.2	1.50
Virginia I.C.&C.pfd.	New York			75	De. 13, Ja. 2, Q	2.50
VANADIUM						
Vanadium Corp.	New York	27⅛	26	27	Jan., 1921	1.00
ASBESTOS						
Asbestos Corp	Montreal	49	44	47⅛	Fe.1, Fe.15 Q	2.00
Asbestos Corp. pfd.	Montreal	95⅛	86⅛	93	Ap.1, Ap.15, Q	1.50
SULPHUR						
Freeport Texas	New York	12⅛	10⅛	10⅜	Nov., 1919	1.00
Texas Gulf	New York	109½	103	103½	Mh.2, Mh.14,	1.75
DIAMONDS						
De Beers Consol	New York			20⅛	Ja.6, Fe.2	0.95
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	2⅛	2⅛	2⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	47⅜	46⅛	46⅜	Fe.18, Mh.2 Q	0.75
Amer. Metal pfd.	New York			114⅛	Fe.19, Mh.2, Q	1.75
Amer. Sm. & Ref.	New York	95⅛	91⅞	92⅛	Ja.16, Fe.2, Q	1.50
Amer.Sm.&Ref.pfd.	New York	108	107⅛	107⅛	Fe.6, Mh.2 Q	1.75
Consol. M. & S.	Montreal	69	60	62⅛	De.11, Ja.15 SA	0.75
Federated Metals	N Y. Curb			37⅛		
Southwest Metals	N. Y. Curb			*75		
U. S. Sm. R. & M.	New York	37⅞	33⅛	34⅛	Ap.6, Ap.15	0.75
U.S. Sm. R.&M.pfd.	New York	46	45¼	46	Ja.8, Ja.15	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

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